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ENVIRONMENTAL IMPACT STATEMENT

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WESTMORELAND RESOURCES'

ABSALOKA MINE

REVISED PLAN

BIG HORN COUNTY, MONTANA

Montana Department of State Lands
and United States Department of the Interior

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Type of Statement: Draft Environmental Impact Statement

Lead Agencies:

State of Montana, Department of State Lands
U.S. Department of the Interior, Office of Surface Mining, Reclamation and Enforcement

Cooperating Agency:

U.S. Department of the Interior, Bureau of Indian Affairs

Proposed Action:

Approvals to mine an additional 629 acres of Westmoreland Resources' Absaloka Mine.

For additional information or copies of this EIS, please contact:

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May 30, 1984

Dear Reader:

Enclosed for your review is a draft environmental impact statement for Westmoreland Resource's revised plan at the Absaloka Mine in Big Horn County. The Montana Department of State Lands and U.S. Office of Surface Mining would like your comments.

The document analyzes in detail the environmental impacts of Westmoreland's plans for the next 13 years. These plans would extend mining into sections 24 and 25 of T1N, R37E and section 19 and 30 of T1N, R38E. The document also analyzes Westmoreland's long-range plans, which cover the next 34 years. Considered in the document's analysis are impacts on a variety of resources, such as water, air, soils, vegetation, wildlife, land use, social and community services, and fiscal conditions.

Your comments must be received by July 30, 1984. If comments or new information require major changes in the analysis, a final EIS will be issued before a decision is made on the proposed mining and reclamation plan. The final EIS may incorporate portions of the draft EIS by reference, so please retain this copy for later use.

Send your comments to the attention of Mr. Kit Walther, Environmental Analysis Bureau, Montana Department of State Lands, Capitol Station, Helena, Montana 19620.

If substantial interest is shown, the agencies may hold a public hearing. We must receive notification of interest for such a hearing within 20 days from the date of this letter.

Additional detailed information on Westmoreland's plan is available from the Department's Helena or Billings offices or the U.S. Office of Surface Mining's Denver office.

J. Lisle Reed

J. Lisle Reed, Acting Director
U.S. Office of Surface Mining
U.S. Department of the Interior

Gary Amestoy

Gary Amestoy, Administrator
Reclamation Division
Montana Department of State Lands

ca
Enclosure

AN EQUAL OPPORTUNITY EMPLOYER

NRIS #59

Draft

ENVIRONMENTAL IMPACT STATEMENT

WESTMORELAND RESOURCES'
ABSALOKA MINE
REVISED PLAN

May 1984

Montana Department of State Lands

Dennis Hemmer

Dennis Hemmer, Commissioner

U.S. Office of Surface Mining

J. Lisle Reed

J. Lisle Reed, Acting Director

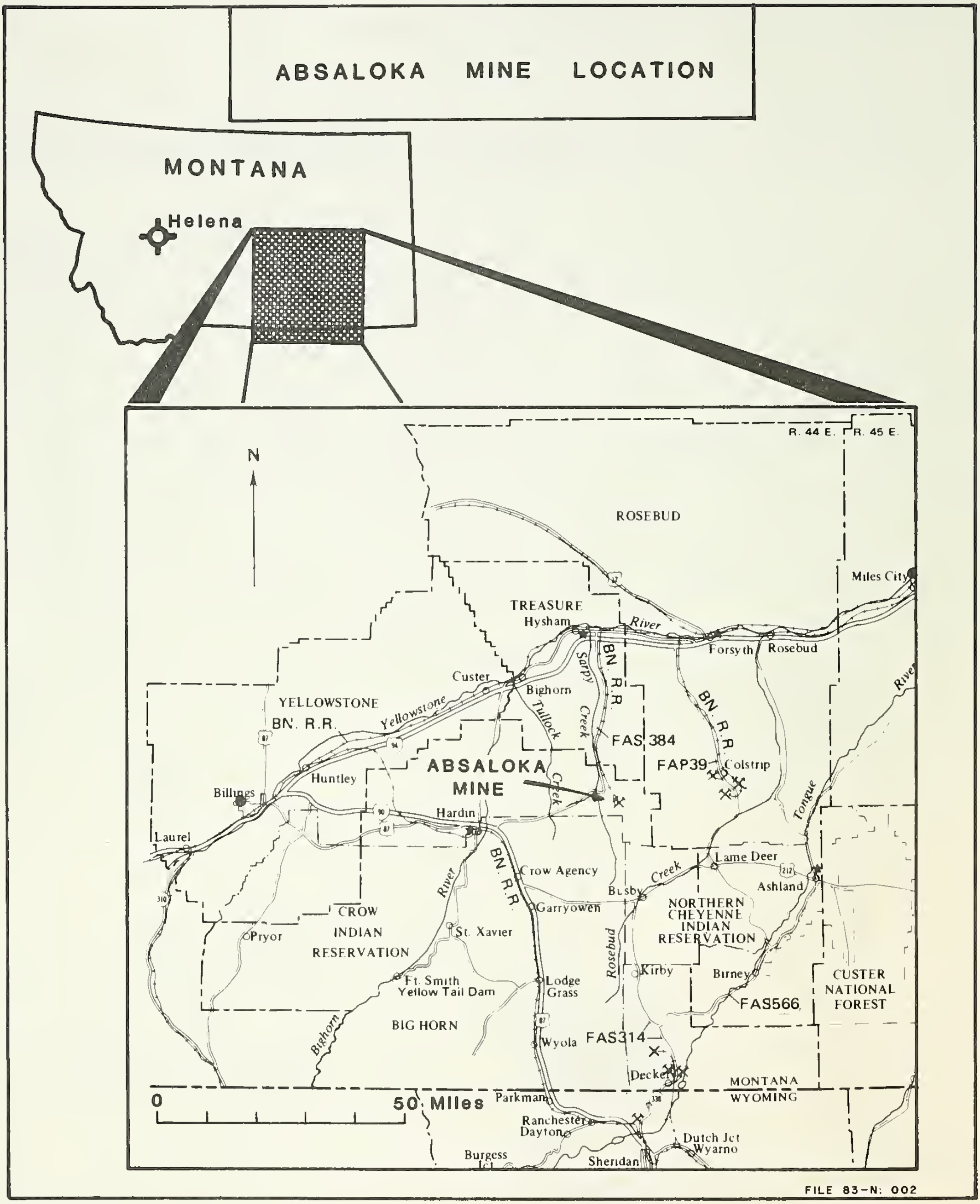

FIGURE S-1

The mine lies on the eastern edge of Big Horn County, 26 miles east of Hardin, the county seat. Just south of the mine is the Crow Indian Reservation. Just west, Sarpy Creek flows north to the Yellowstone River.

ABSALOKA MINE
REVISED PLAN

Action Under Consideration

Westmoreland Resources has submitted an application to mine an additional 629 acres at the Absaloka Mine (fig. S-1). The Commissioner of the Montana Department of State Lands and the Secretary of the Department of the Interior are required to make a decision on whether to issue the necessary approvals for mining.

The Company's Proposal

Westmoreland proposes to mine an additional 65 million tons of coal in the permit application area. Mining would take place over 13 years at a rate of about 5 million tons per year. The coal in the application area would come from Crow Indian coal leases. If the permit application is approved, the company could begin operations in the new area in 1985.

The lands proposed for mining under the new application have been analyzed in previous long-range mining plans and environmental evaluations. The mining and reclamation plans, however, have changed.

Along with the permit application, the company has submitted preliminary plans for the remainder of the mine's life. Although these plans do not apply specifically to the pending decision, they are evaluated in this environmental impact statement to the extent possible. In the life-of-mine plan, the company would mine an additional 208 million tons of coal from 2,096 acres, and the mine would close in 2017. Unlike the proposed plan, the life-of-mine plan includes some acreage that has not been previously evaluated. (See chap. I.)

Summary of Impacts

Geology: Throughout the mine area, some erosion and sedimentation of reclaimed lands would be unavoidable. The two permanent impoundments proposed to replace the springs destroyed or dried up by mining would probably function as intended with long-term maintenance. Moderate problems with drainage system stability may eventually arise. The company's application plan would establish a postmining rootzone that is acceptable for plant growth. Some of the rootzone spoil could contain elevated levels of molybdenum, which in turn could cause a copper-molybdenum imbalance in forage.

Hydrology: Eight springs would be removed by mining in the application area and at least three other springs would probably cease flowing during mining due to associated disturbances and lowered water tables. The proposed plan to restore surface water supplies would be partially successful; therefore, the loss of springs would be permanent (with the possible exception of spring 12), reducing the spring water in the mine area. In the life-of-mine plan, another ten springs would be lost. Because the springs would be replaced with two permanent impoundments, impacts to the local hydrologic system would be minimal. No impacts are likely to occur to East Fork Sarpy Creek.

Soils: The disturbance area contains excessive amounts of fine sandy loam soil. If salvaged and replaced without selective handling, soil losses could occur in some localized areas, especially on the steep drainage side slopes. Coulee-bottom soils are often wet, and if salvaged when wet, would cause severe compaction and total deterioration of soil structure, which could adversely affect revegetation of coulee bottoms.

Vegetation: Mining of the application area would destroy 573 acres of vegetation over 13 years. After revegetation, grasslands would cover 74 percent of the disturbance area compared to 35 percent at present. This would increase livestock forage production, although plant species diversity would decline. Agricultural land (cropland) and the closed-canopy ponderosa pine forest would be eliminated. The amount of deciduous shrubs, trees, and vegetation beside ponds would decline substantially. Reestablishment of the open-canopy pine forest would probably succeed.

Aquatic Ecology: Aquatic habitat and associated organisms would be substantially reduced in the North Coulee's drainage area. This impact would be significant in the application area. However, this reduction would not be regionally significant. No threatened or endangered species exist in the North Coulee.

Wildlife: Mining in the application area would temporarily force wildlife from, and destroy, 573 acres of habitats, including one great-horned owl nest. After mining, reclaimed lands would supply foraging areas for deer, turkeys, and sharp-tailed grouse. However, the change in water sources (with associated vegetation) and the decreased acreage of woody cover would lower habitat quality for deer, turkeys, grouse, waterfowl, and several nongame species. Also, decades would be required for reestablished ponderosa pines to supply adequate cover. Although mining would have significant impacts on many wildlife species on the application area, no regional effects are anticipated.

Climate: Continued mining would not affect the climate.

Air Quality: During maximum production, mining would cause significant impacts to present air quality. Total suspended particulate (TSP) concentrations would increase, especially close to mining and the processing facilities. But the Montana and Federal Ambient Air Quality Standards would not be exceeded.

Economics: Impacts to the local economy would not be significant. Any new mine jobs resulting from increased coal production are likely to go predominately to Crow Indian workers. At maximum, 140 more jobs would be created at the mine. In the county, total employment is projected to continue to grow at current, modest rates through the life-of-mine period. At full production, the mine's payroll would increase from $4.1 million to $8.7 million per year.

Social Conditions: The continued operation of the Absaloka Mine would not cause significant impact to the social organization, population, or housing of Big Horn County, the Crow Reservation, or the Northern Cheyenne Reservation.

Social and Community Services: More social and community services would be needed in Big Horn County and on the Crow Reservation in the future. All new service demands would come from natural population increase, not the continued operation of the Absaloka Mine. Thus, impact to social and community services from mining activity would be minor.

Fiscal Conditions: In the application and life-of-mine plans, tax revenues would vary with coal production, but the general fiscal condition of the government units surrounding the mine would remain unchanged from recent years.

Land Use: Mining would temporarily eliminate agricultural uses on the minesite. After reclamation, cropland would be eliminated, ponderosa pine would decrease, and the amount of rangeland would increase. The loss of agricultural production to the region would be negligible.

Transportation: Mining as proposed would not noticeably change the amount of vehicle traffic on FAS 384 or the congestion at railroad crossings used by unit coal trains. Increased mining, at annual production rates up to 10 million tons per year, also would not noticeably affect highway traffic, but would aggravate railroad crossing congestion.

Outdoor Recreation: Further mining at the Absaloka Mine would not affect the quality of recreation in the region.

Cultural Resources: The mine would not affect significant historical or archeological sites in the mine area.

Aesthetics: The mine operations would initially destroy the landscape of the mine area. After mining, reclamation would blend the minesite with surrounding lands. In the long term, aesthetic impacts would be insignificant.

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THE EIS: WHY IT IS WRITTEN
WHO TAKES PART
WHAT DECISIONS MUST BE MADE

Since opening the Absaloka Mine in 1974, Westmoreland Resources Inc. has received approval to mine 2,630 acres. Westmoreland is seeking approval from the Montana Department of State Lands, in accordance with the Montana Strip and Underground Mine Reclamation Act, and the U.S. Department of the Interior, in accordance with the Surface Mining Control and Reclamation Act and the Omnibus Indian Mineral Leasing Act, to mine 629 more acres. If approved, mining of the new area would begin in 1985.

Westmoreland's Absaloka Mine is located within the Crow ceded area. For the action analyzed in this EIS, the federal government and the state of Montana do not agree as to whether the coal currently being mined by Westmoreland pursuant to a lease from the tribe is or is not "Indian lands," as the term is defined in the Surface Mining Control and Reclamation Act (SMCRA). Furthermore, if the coal is Indian lands, the agencies do not agree as to which is the regulatory authority. Consequently, both DSL and OSM have asserted jurisdiction and are reviewing the application jointly without conceding each other's jurisdictional claim.

THE EIS

The Department of State Lands (DSL) and the U.S. Department of the Interior (DOI) have determined that a decision on Westmoreland's application may "significantly affect the quality of the human environment." Therefore, before making a decision on the company's application, DSL and DOI are required to prepare an environmental impact statement (EIS) (Montana Environmental Policy Act [MEPA], 1971, and National Environmental Policy Act [NEPA], 1969). Within DOI, the Office of Surface Mining, Reclamation and Enforcement (OSM) is the lead agency and the Bureau of Indian Affairs (BIA) is a cooperating agency.

As required by MEPA and NEPA, the general procedure for DSL and DOI to follow is to--

(1) issue this draft EIS.

(2) encourage and accept public comments on the draft.

(3) issue a final EIS that contains--

  (a) corrections or clarifications of the draft EIS and

  (b) responses to public comments.

After publishing the final EIS, DSL and DOI must make a decision on Westmoreland's application. The Department of State Lands can make a decision no sooner than 15 days following publication of the final EIS; DOI can make a decision no sooner than 30 days following publication by the U.S. Environmental Protection Agency that the final EIS is available.

The EIS analyzes (1) the company's proposal, (2) the lands, people, and resources that the proposal would affect, and (3) the consequences (or impacts) of the proposal. The EIS does not present DSL's or DOI's decision. The document is used as one of the tools in making the decisions. The preparation of the EIS helps ensure the proposed operation is well planned and that the concerns of all agencies, organizations, and citizens are considered before a decision is made.

PREVIOUS DOCUMENTS AND RESEARCH

Since Westmoreland first applied for approval to mine in the early 1970s, a number of documents have been written analyzing the Absaloka Mine (U.S. Department of the Interior [USDI], 1974, 1976, and 1977; Montana Department of State Lands [MDSL], 1977 and 1979; and USDI and MDSL, 1980). Two of them, one prepared by the U.S. Geological Survey (USDI) in 1977 and the other by the Department of State Lands in 1979, were EISs that analyzed Westmoreland's original 20-year mining and reclamation plan. The present application is a revision of the 20-year plan. The proposal contains a larger mine area and more data on the area to be mined.

This EIS does not repeat all analyses contained in the earlier EISs. All aspects of the mine are described, but a detailed discussion is included only of topics that, for various reasons, require further analysis. The reader interested in past analyses is referred to the 1977 and 1979 documents:

U.S. Department of the Interior, Geological Survey. 1977. Final Environmental Impact Statement--Proposed 20-Year Plan of Mining and Reclamation. Westmoreland Resources Tract III, Crow Indian Ceded Area, Montana. Reston, Virginia. 495 pages and 5 appendixes.

Montana Department of State Lands. 1979. Final Environmental Impact Statement--Westmoreland Resources, Inc., Absaloka Mine. Helena, Montana. 122 pages. [Draft EIS incorporated by reference.]

This EIS analysis draws data from many sources in addition to the two previous EISs. Each source is listed under Literature Cited at the end of the EIS. Two of these documents deserve special mention here.

The application, a 12- volume set, contains detailed, comprehensive data on most of the topics in the EIS. The data, collected over the last decade, range broadly, covering such topics as hydrology, vegetation, soils, archeological sites, wildlife, and aquatic ecology. Much of the information found in the EIS comes from exhaustive descriptions and species inventories in the application. For those interested, the application is available for review at the Department of State Lands, Helena and Billings, and the Office of Surface Mining, Denver.

Since the permit application does not cover socioeconomic topics, DSL and OSM have relied on a comprehensive study of the social conditions and economy of the area surrounding the Decker mines (Mountain West Research-North Inc., 1983). The resulting report, a 1,600-page document submitted with many smaller special reports, discusses Sheridan County, Wyoming, Big Horn County, Montana, and the Northern Cheyenne and Crow Indian Reservations. The impacts of the Absaloka Mine are included in the information for Big Horn County.

Much of the EIS's coverage of social sciences, such as taxes, schools, population, and housing, comes from the Mountain West report. The report can be reviewed at a number of local government offices, including DSL and OSM. For most people, the easiest way to review a copy is to request one from the state library system through interlibrary loan.

SCOPE OF ANALYSIS

To assist in defining the scope of this analysis, DSL and OSM mailed 500 questionnaires in August 1983 to people interested in the Absaloka Mine. Concerns raised in the questionnaires are listed below. These concerns, and those of DSL and OSM, are evaluated in the EIS.

- How would hunting and habitat loss affect wildlife?
- What impacts would there be on surface and ground water? Would there be any impacts on the main or East Fork of Sarpy Creek? Would water tables change in alluvial valley floors? Will ground water tables and flows be reestablished after mining? How?
- How would the mine affect employment?
- How would the mine affect tax revenues?
- Can coulee-bottom vegetation be reestablished after mining? Will deciduous shrubs, even those planted as tublings, survive?

In analyzing the range of alternatives available to DSL and DOI, the EIS evaluates both the immediate and cumulative effects of Westmoreland's mining and reclamation plan. Included in the analysis are the impacts resulting directly from mining and those resulting from increases in employment and economic activity.

The EIS covers two levels of mine development. Analyzed in the greatest detail is Westmoreland's proposed (13-year) plan, for which the most information is available. (See chap. I.) The company's "life-of-mine" plan, scheduled to end in 2017, is analyzed to the extent possible.

METHODS AND STUDY AREAS

For each topic in the EIS, the methods of analysis and the boundaries of the lands studied often differ. The four most often mentioned boundaries are the permit boundary, the application boundary, the life-of-mine boundary, and the Tract III boundary (fig. IN-1).

The existing permit boundary includes all lands for which Westmoreland now holds a mining permit. The application boundary includes the lands covered in Westmoreland's current application (the 13-year plan). The life-of-mine boundary covers the lands Westmoreland expects to mine in the future. The Tract III boundary includes the lands for which Westmoreland holds coal leases from the Crow Tribe of Indians.

An additional area often mentioned is Big Horn County. For most purposes, this is the social sciences study area. Under some topics, descriptions extend to more distant areas.

The analysis of social science topics used a number of techniques, including field observation, interviews, surveys, and use of Mountain West Research's Planning and Assessment System (PAS) computer model for forecasts of population, employment, and income. For a complete description of the social science study, see appendix A.

The analysis of natural science topics also used a variety of techniques. Where pertinent, these methods are discussed in chapters II and III.

ALTERNATIVES UNDER CONSIDERATION

After evaluation of the EIS and Westmoreland's application for approval to mine, DSL and DOI may take one of the following five alternatives.

1. Approve the Application as Proposed

The environmental effects of approving the application as proposed are discussed in chapter III.

2. No Action

If no action were taken by DSL within 240 days after receipt of a completed application, it is possible that approval could occur by default. Montana does not have a formal administrative alternative to defer action following the receipt of a completed mine and reclamation plan.

OSM has no legally required deadline for approval, but may not defer its decision indefinitely. Because Westmoreland has submitted a complete application, a decision must be made. No action is not a reasonable alternative for OSM.

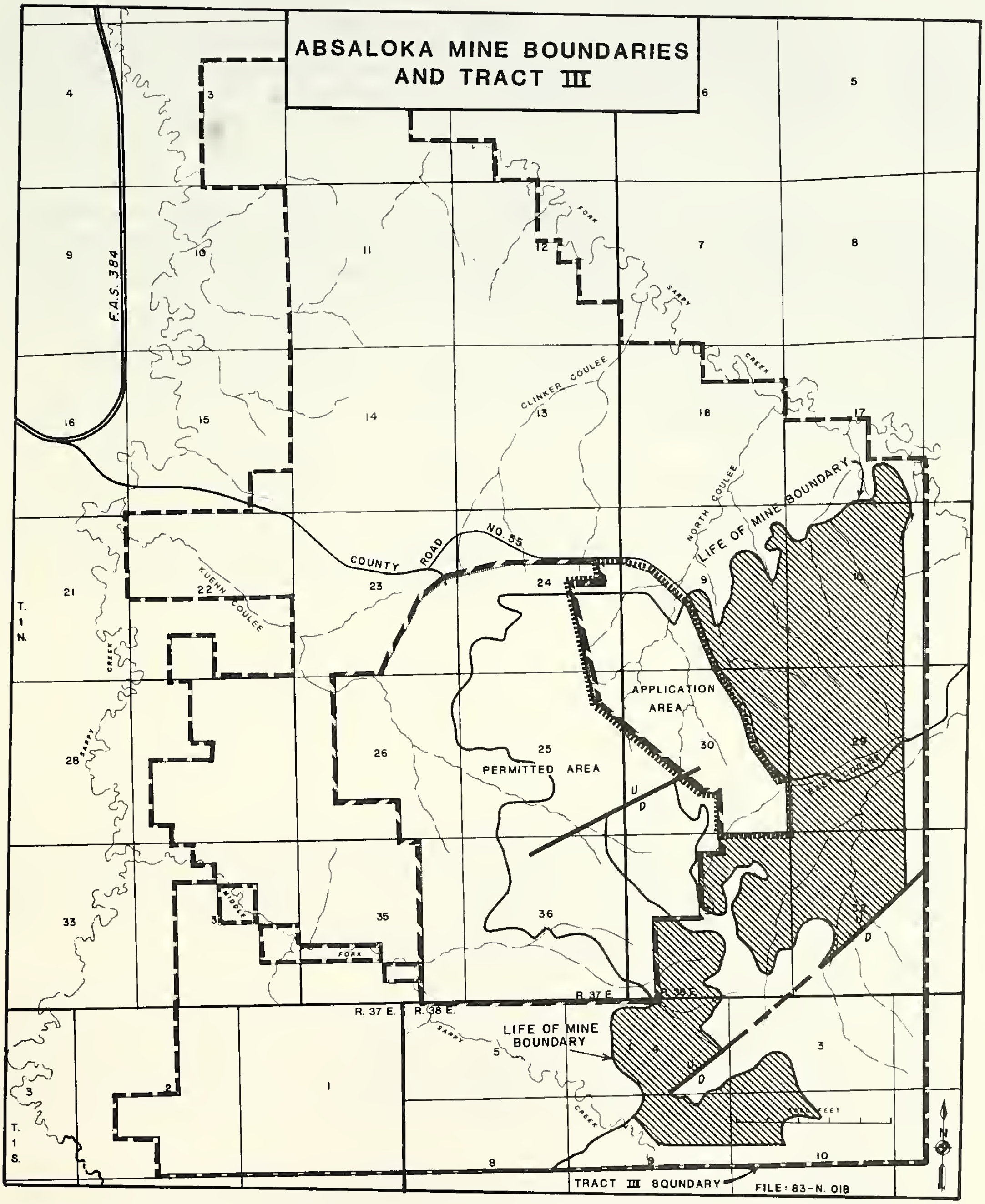


FIGURE IN-1

Boundaries most often mentioned in the EIS include Tract III (the Crow Indian coal lease) and the three boundaries in the mine area.

3. Reject the Application

DSL or OSM may reject an application that does not meet program requirements. The effects of rejection would be that the physical environment would remain as described in chapter II. The changes in the social and economic conditions that would result from application rejection are described in chapter IV.

4. Selectively Denying Approval

DSL or DOI can deny approval for mining specified areas where program reclamation requirements cannot be met. The specified areas would include, for example, those having special, exceptional, critical, or unique characteristics, or where mining would affect the use, enjoyment, or fundamental character of neighboring land having the above special characteristics (82-4-227 MCA). The impact analysis in this EIS has not disclosed any such lands, but that does not preclude such action following review of this EIS.

5. Approve Mining with Special Conditions

If parts of the proposed plan were considered unacceptable, DSL and DOI could approve mining with special conditions. Modifications identified in this EIS that would reduce the impacts of the mine are listed as separate sections at the end of each subject in chapter III. These sections are titled "Mitigating Measures." Not until issuance of the approvals to mine would it be known which, if any, mitigating measures would be attached to the permit as special conditions.

OTHER ALTERNATIVES

Technical Alternatives

DSL and OSM also considered alternative ways of mining the coal at the Absaloka Mine, but the other methods are either impractical or inferior to the proposed dragline strip-mining operation proposed by Westmoreland. As a result, no alternative mining methods have been analyzed in detail in this EIS. Alternative mining methods considered but rejected include auger mining, underground mining, and truck-and-shovel mining.

Although practiced in some nearby mines, truck-and-shovel mining has one major drawback: higher cost. Where the topography is rolling and dissected, or where the company must selectively handle toxic overburden, truck-and-shovel mining may be preferred, despite the cost. At the Absaloka Mine, neither the topography nor the overburden would give truck-and-shovel mining an advantage.

Underground mining has several disadvantages. Although an underground method would not disturb the soil and rock strata overlying the coal, the land surface could subside after mining, as the underground mine workings collapsed. The resulting depressions and holes would limit land use for livestock grazing. A further problem might be underground coal fires, which can start when unextracted coal is exposed to air. Such fires can burn for years, despite repeated efforts to extinguish them. Underground mining also recovers considerably less coal than strip mining: the most efficient techniques recover about 80 percent, compared to the over 87.5 percent Westmoreland expects to recover.

Auger mining could be used in conjunction with strip mining to recover additional coal in highwalls and along outcrops. In highwalls, for example, the auger could bore into the coal seams beyond the economic limit of overburden removal for coal stripping. Auger mining, in this case, would not replace strip mining, but would be used as a minor supplement to the strip-mining methods already proposed.

Auger mining, like underground mining, has two drawbacks. The holes left by the auger would be costly and difficult to seal. In addition, the company would recover less than 50 percent of the coal, leaving the remaining coal unrecoverable by conventional techniques.

WESTMORELAND RESOURCES'
ABSALOKA MINE

WESTMORELAND'S PROPOSAL

Westmoreland Resources Inc. has revised its long-range plan for mining at the Absaloka Mine in Big Horn County. The revised plan calls for two changes from the 20-year plan evaluated in the 1977 U.S. Geological Survey and 1979 Department of State Lands EISs. The first is a change in the sequence and timing of mining over the next thirteen years. Westmoreland has submitted this change, in detail, in a new permit application package (fig. I-1).

The second change would enlarge the entire area scheduled for mining, an area that would be worked until 2017, the year the mine would close (assuming two years for reclamation) (fig. I-2). For this life-of-mine area no detailed plans are available. Westmoreland would submit detailed plans as it applies for future approvals to mine.

The Absaloka Mine lies between the main fork and East Fork of Sarpy Creek, about 26 miles east of Hardin, Montana, via FAS 384 and County Road 55. The company opened the mine in 1972 and since then has expanded the mine acreage steadily. Currently, 2,630 acres are under permit.

In the application Westmoreland has submitted, the company proposes to add 629 acres to the permitted area. Of this, 573 acres (called the disturbance area) would be mined over 13 years (fig. I-1). Mining in the new area would begin in 1985. In the life-of-mine plan, the company would add another 2,096 acres, bringing the total mine area to about 5,355 acres (fig. I-2).

The existing mine covers all or part of sections 23, 24, 25, 26, 35, and 36 of T1N, R37E and sections 30 and 31 of T1N, R38E. Westmoreland's proposal would extend the mine in sections 24 and 25 T1N, R37E and sections 19 and 30 T1N, R38E (fig. I-1). The life-of-mine plan would further extend the mine in sections 17, 19, 20, 29, 30, 31, and 32 T1N, R37E and sections 3 and 4 T1S, R38E (fig. I-2).

Westmoreland has designed the Absaloka Mine to produce up to 10 million tons of coal per year. Owing to the soft coal market, however, the mine now produces only 4 million tons per year. No increase is expected within the near future, probably not until the late 1980s. At today's production rate, the mine could operate long after 2017.

For planning purposes, the company proposes to mine an average of 5 million tons per year until 1987. Production would then grow, rising to 10 million tons per year by 1992 and remaining there through the life of the mine (table I-1). If the coal market improves, the company would raise the production rate earlier than 1987. Coal production rates would then vary, reaching a maximum of 10 million tons per year (the same maximum proposed in the former 20-year plan). Figure I-2 depicts this more optimistic schedule.

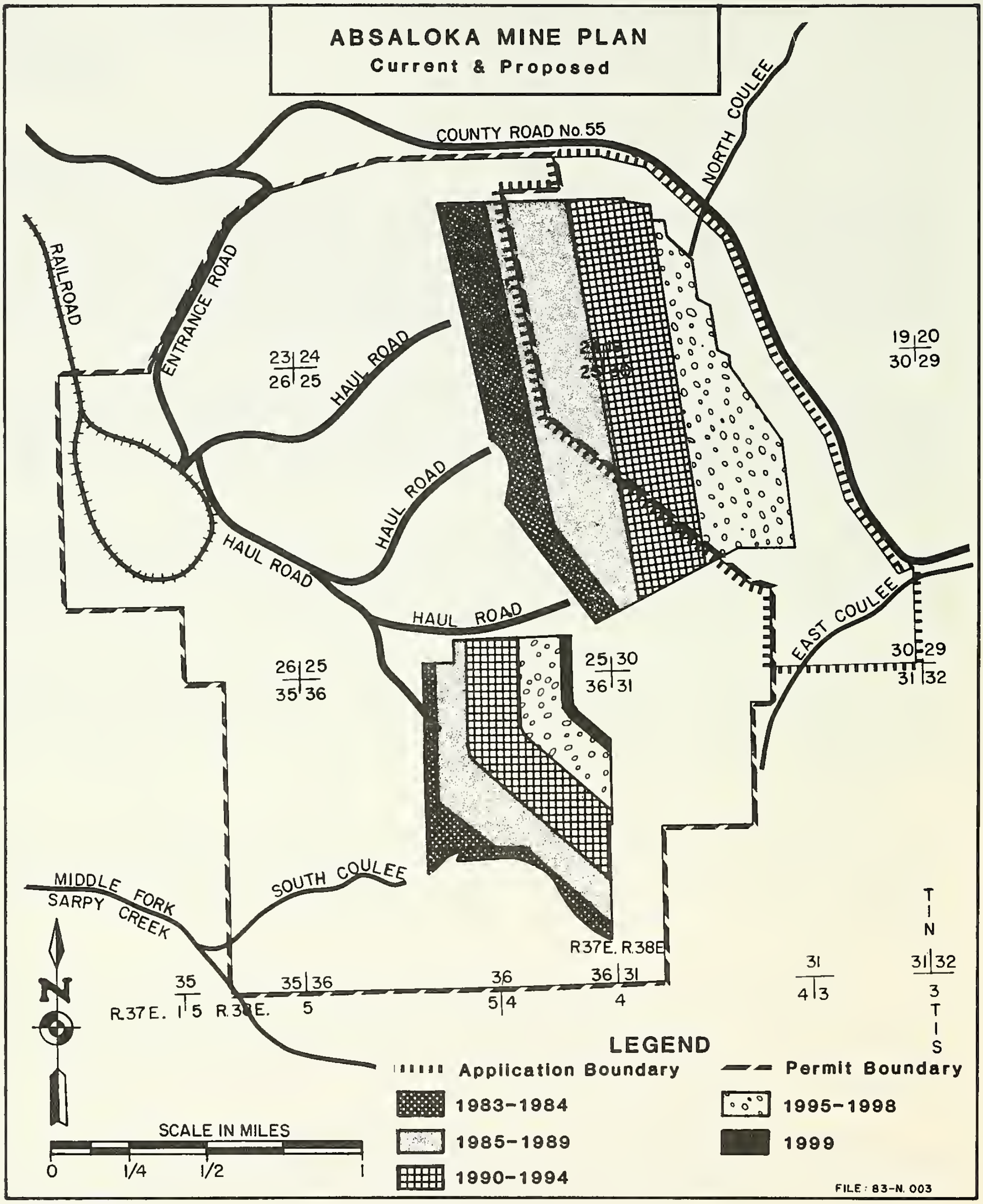


FIGURE I-1

Plans call for the dragline to advance eastward, moving by 1985 into the new 629-acre application area. The lands between the cuts shown and the facilities area have already been mined.

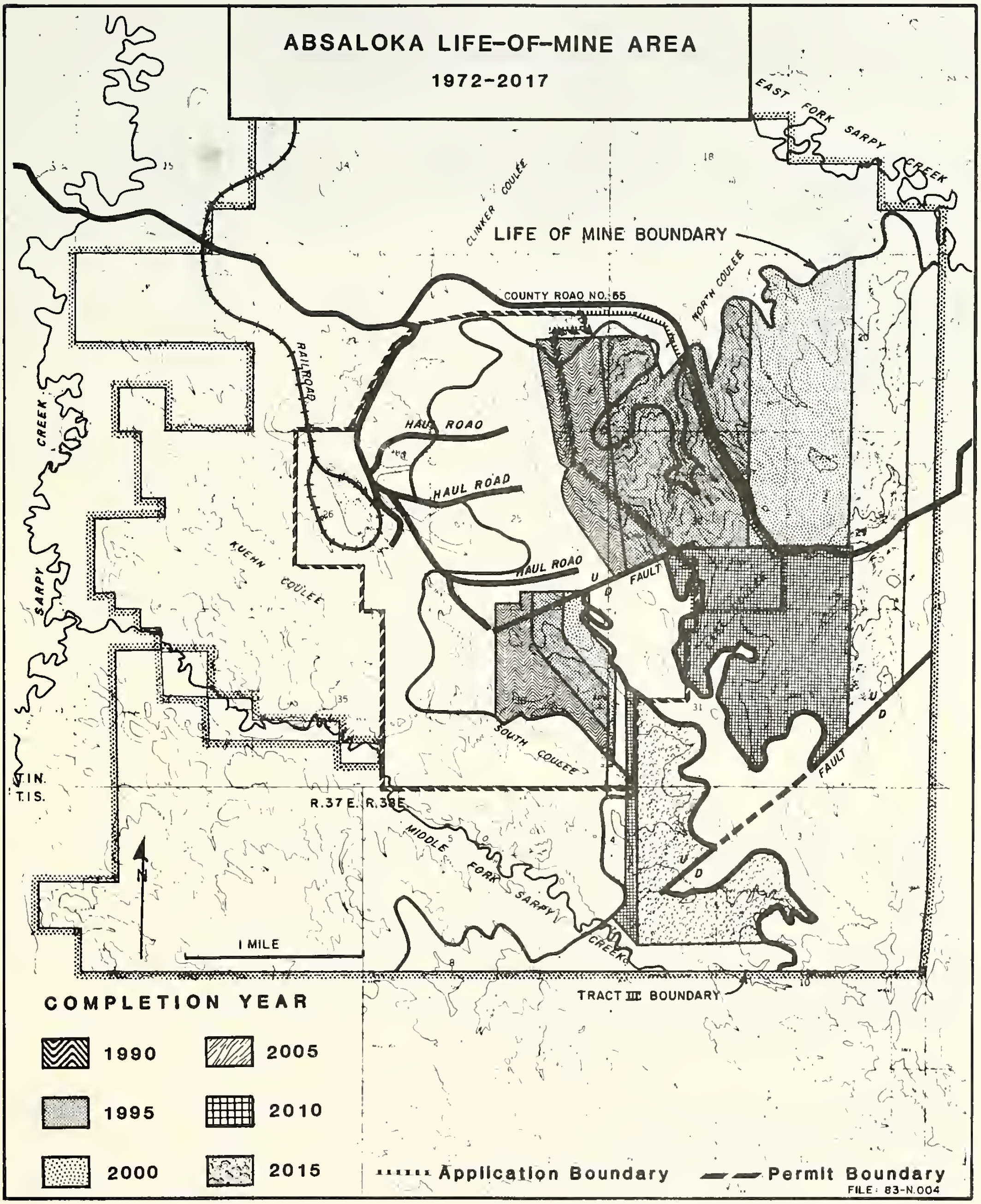


FIGURE I-2

Over the next 34 years, Westmoreland hopes to mine both the application and life-of-mine areas. The company would not mine lands that have more than 150 feet of overburden over the coal.

TABLE I-1

Past and Proposed Absaloka Mine Coal Production

Year	Permit Application Coal Production (millions of tons)	Life-of-Mine Coal Production (millions of tons)
1974	1.5	1.5
1975	4.0	4.0
1976	4.1	4.1
1977	4.5	4.5
1978	4.5	4.5
1979	5.0	5.0
1980	4.9	4.9
1981	4.5	4.5
1982	4.2	4.2
1983	3.5	3.5
1984-1987	5.0	5.0
1988-1989	5.0	6.0
1990-1991	5.0	8.0
1992-1997	5.0	10.0
1998-2014	0	10.0
TOTAL	110.7	318.7

Note: To date, 40 million tons of coal have been produced. An additional 278 million tons would be produced over the life of the mine.

Source: David W. Simpson, Absaloka Mine General Manager, written commun., September 6. 1983.

Before mining the application area, Westmoreland Resources would have to increase the reclamation bond covering the permit area. For the 3,225-acre permit area including the application area, Westmoreland would bond a total of 2,347 acres for mining-level disturbance, 221 acres for facility-level disturbance, and 657 acres for associated disturbance. (Mining-level disturbance includes mining and overburden stockpiles; facility-level disturbance includes haul roads, access roads, sediment ponds, the railroad loop and siding, and mine facilities; associated disturbance includes topsoil stockpiles, ditches, fences, and other minor disturbances.)

COAL RESERVES AND PRODUCTION

Four coal seams underlie the Absaloka Mine. From top to bottom these include the Stray 1, Rosebud-McKay, Stray 2, and Robinson. The Stray seams are thin, discontinuous, and often of poor quality. Westmoreland would mine these seams only when they are recoverable and marketable. The Stray seams each reach a maximum of 5 feet in thickness.

Westmoreland's primary objective is to mine the Rosebud-McKay and Robinson seams. The Rosebud-McKay is 30 to 35 feet thick and lies under 70 to 135 feet of overburden. The Robinson seam, 50 to 100 feet below the Rosebud-McKay, varies from 17 to 23 feet in thickness. Recoverable coal reserves remaining at the Absaloka Mine total about 278 million tons.

Westmoreland now sells coal from the Absaloka Mine to utilities in the northern Midwest for use in coal-fired electric generating plants (table I-2). In the future, the company would market coal to both northern Midwest and Pacific Northwest utilities.

TABLE I--2

Absaloka Mine Coal Sales
(in thousands of tons)

Company	1978	1979	1980	1981	1982	1983*
Northern States Power Co.	2,550	2,950	3,000	2,900	2,700	2,450
Dairyland Power Cooperative	455	500	500	500	500	450
Interstate Power Co.	305	250	250	300	300	200
Wisconsin Power & Light Co.	200	240	290	170	150	150
Central Illinois Light Co.	770	700	520	240	200	200
Upper Peninsula Generating Co.	175	280	270	270	230	250
Spot Market	98	33	81	78	50	50
TOTAL	4,553	4,953	4,911	4,458	4,130	3,750

Source: David W. Simpson, Absaloka Mine General Manager, written commun., November 19, 1982
* estimated

The State of Montana owns the coal in section 36, T1N, R37E. The rest of the coal in the mine area is leased by Westmoreland from the Crow Tribe of Indians.

MINE FACILITIES

Westmoreland would continue to use the facilities that now service the mine (fig. I-3). Coal-processing structures include a truck dump, primary crusher, secondary crusher, train loadout, and coal storage barn. These facilities can handle 11 million tons of coal per year. Other facilities include an office, shop, change house, boiler house, equipment storage building, repair shop, water treatment plant, coal testing laboratory, and explosive (ammonium nitrate) storage silo.

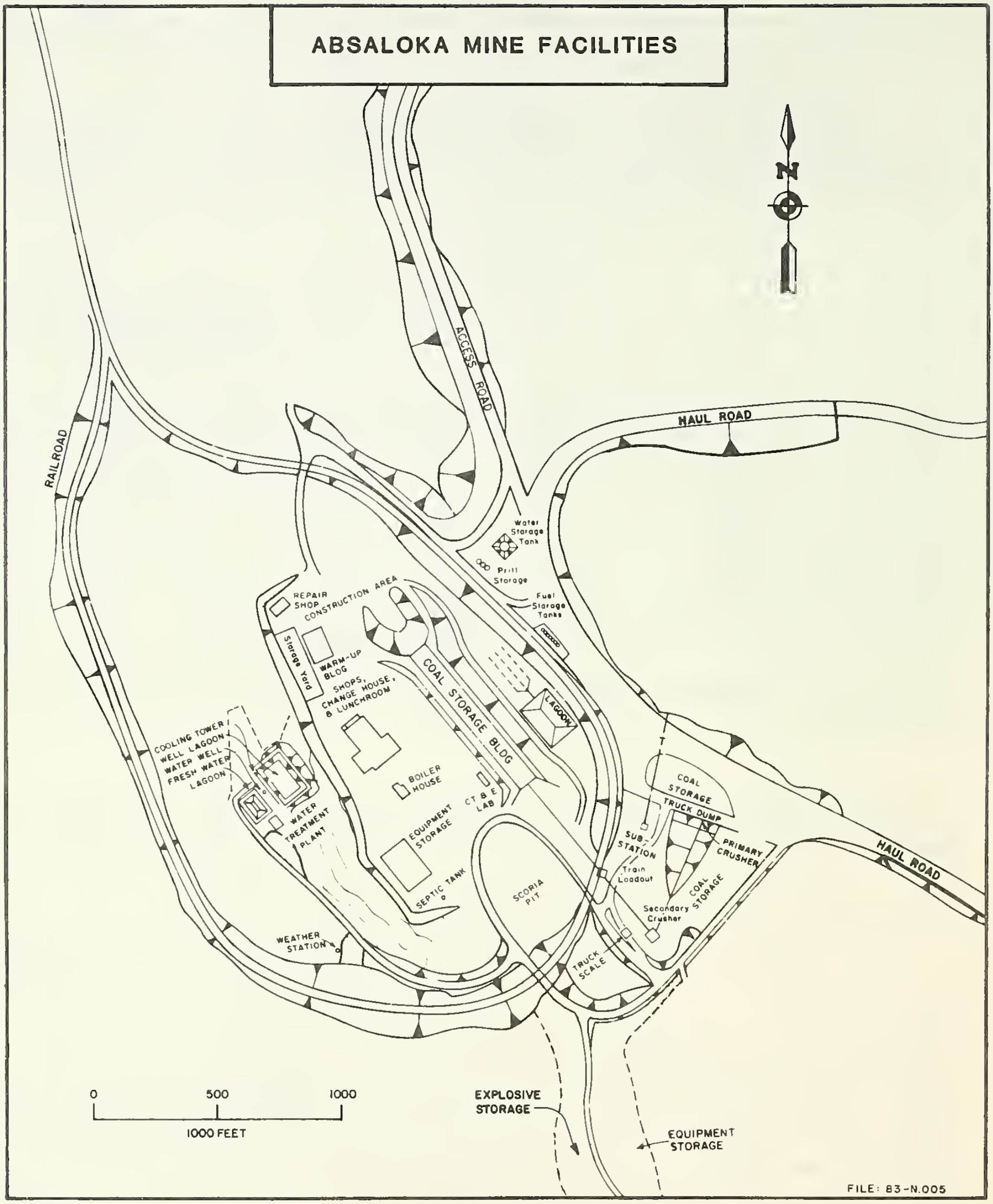


FIGURE I-3

Facilities used by the mine today (encircled by the railroad) would not be changed. As the mine pits advance away from the facilities area, haul roads would be lengthened.

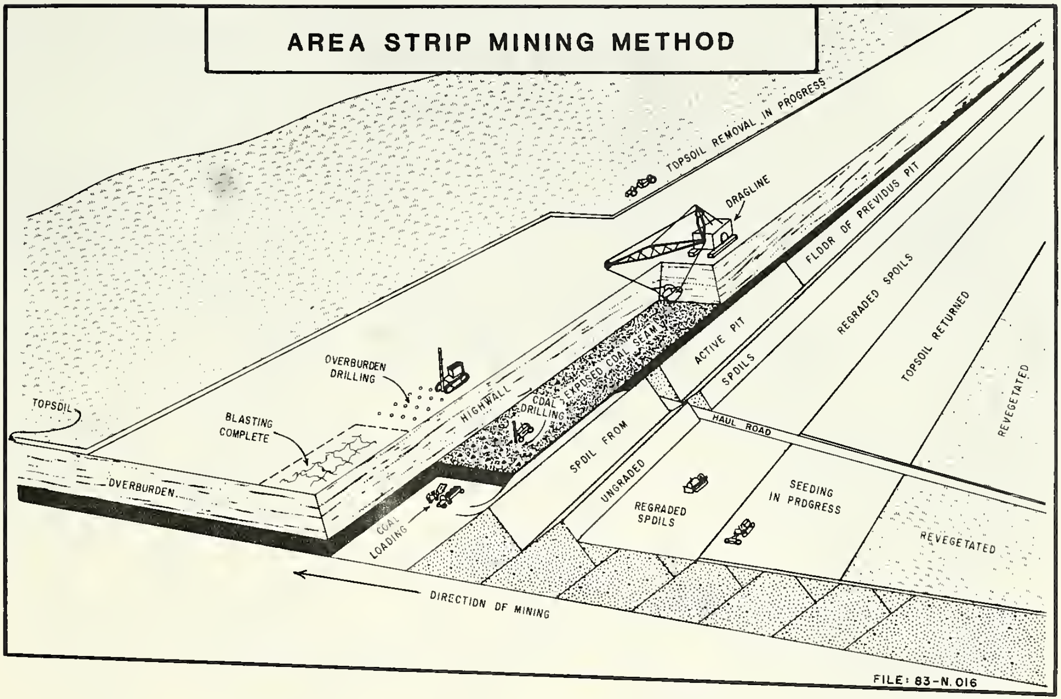


FIGURE I-4

Mine "pits" are actually long troughs cut by the dragline. One pit is cut at a time, the unwanted overburden goes into the mined-out cut. (Note that for simplification only one coal seam is shown in the sketch.)

MINING METHOD

The Absaloka Mine is an area strip mine, where the dragline advances by excavating a succession of long, narrow pits, one alongside the next. Mining has and would continue to move from west to east (fig. I-1).

Mining first begins when scrapers strip the topsoil and subsoil from the surface, keeping the topsoil separate from subsoil (fig. I-4). The dragline then strips the unwanted strata, or overburden, down to the Rosebud-McKay seam. An electric-loading shovel excavates the Rosebud-McKay seam. The parting between the Rosebud-McKay and Stray 2 seams is removed with dozers, and the Stray 2 seam is then removed with a front-end loader. The dragline then strips the remaining interburden, and the electric-loading shovel removes the Robinson seam.

While cutting each new strip, the dragline casts excavated overburden into adjacent strips. After the mined-out strips are filled, bulldozers contour the surface to approximately the premining topography. (See. figs. I-5 and I-6.) Scrapers then replace the subsoil and topsoil and the area is

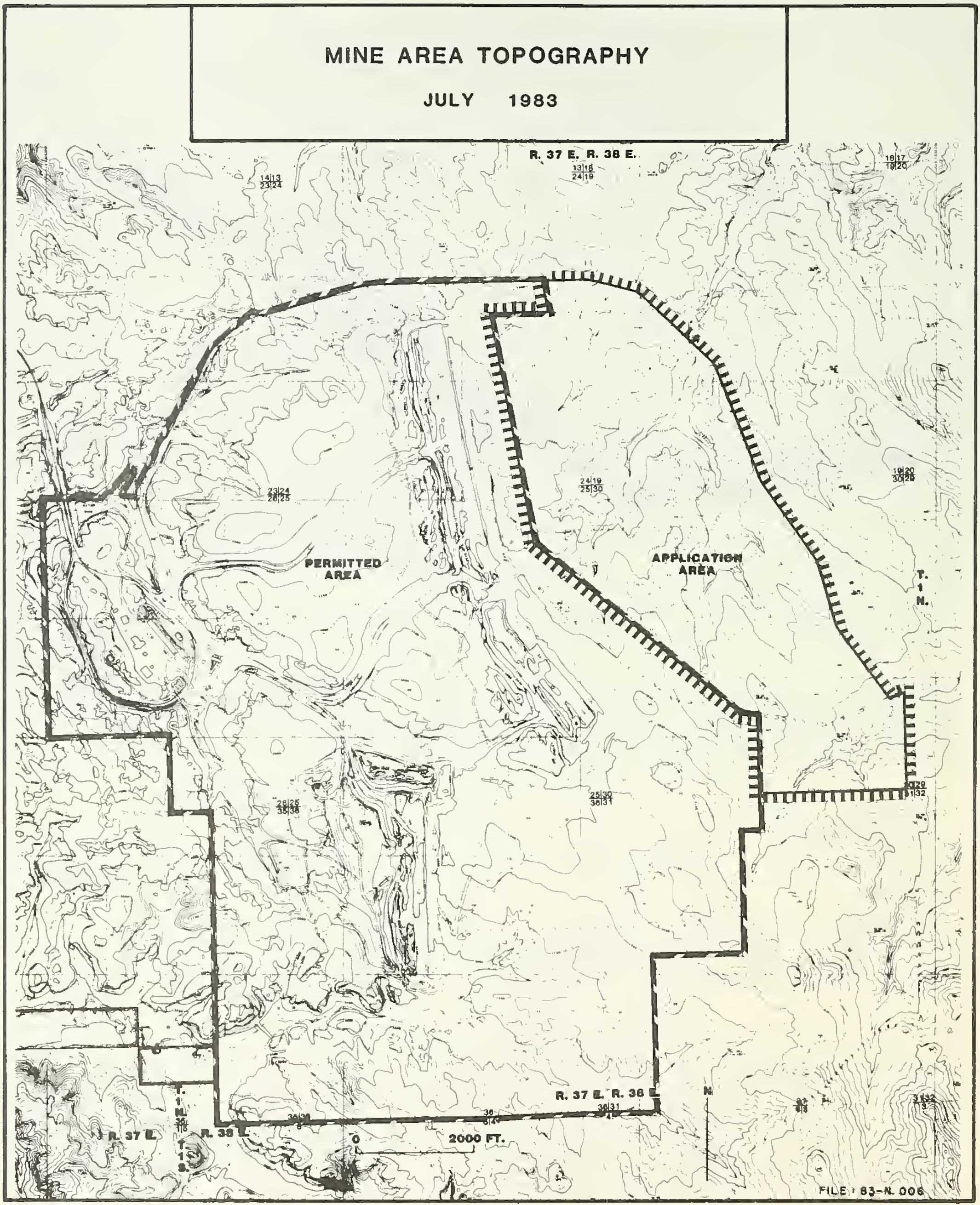
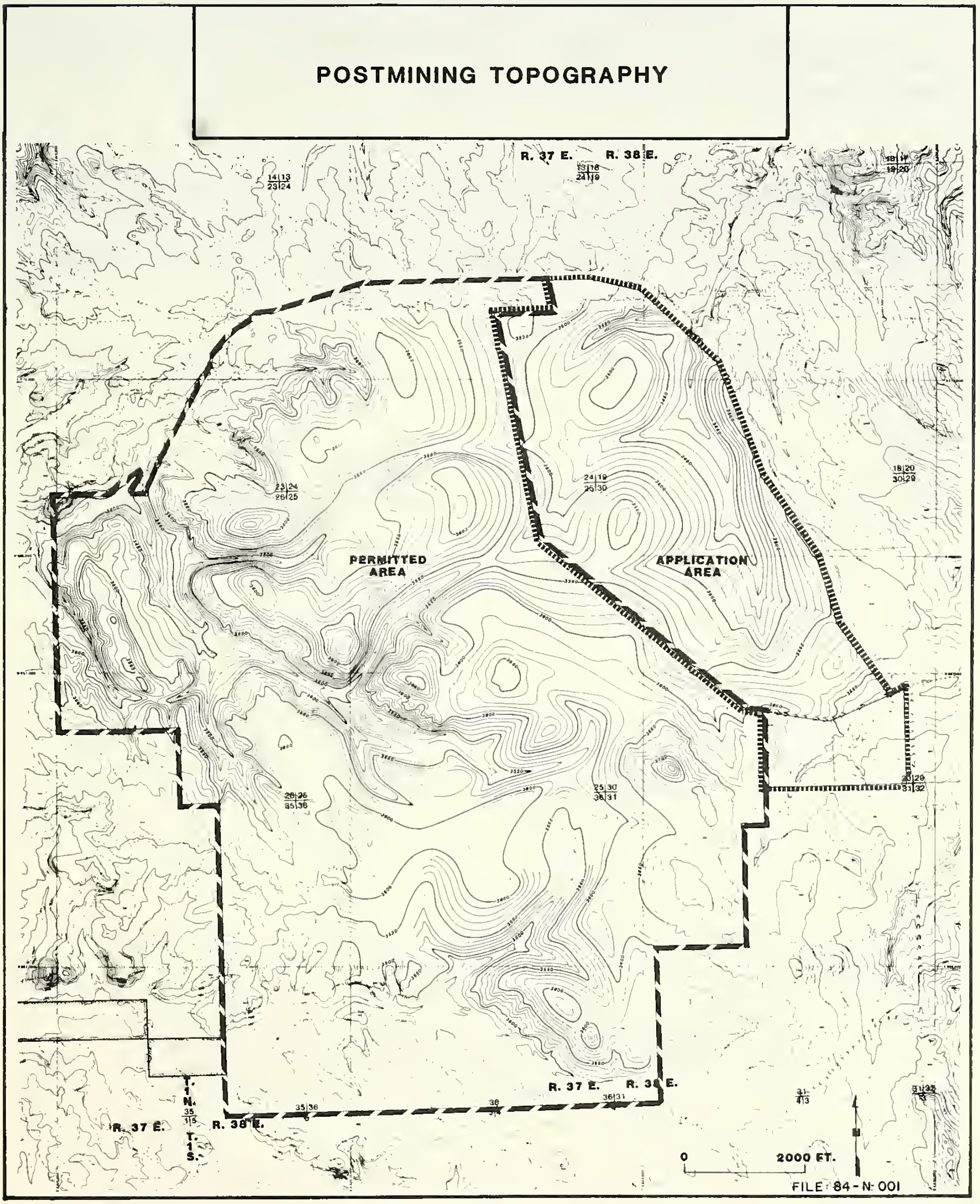


FIGURE I-5

Shown in the figure is today's topography, typified by rolling rangeland and rounded hills. Most of the permitted area topography has been reconstructed after mining. Application area contours are natural.



POSTMINING TOPOGRAPHY

FIGURE I-6

Bulldozers would regrade the excavated overburden (spoil) into the approximate topography and drainage patterns that existed before mining.

reseeded. This completes the reclamation process. In this way, only part of the total mine area is actually cut by a mine pit at one time.

Following a period of plant establishment, most reclaimed lands are returned to the primary premining land use--livestock grazing and wildlife habitat. To date, 276 acres have been reclaimed.

EMPLOYMENT AT THE MINE

The mine now employs 120 workers. Table I-3 lists past and projected employment.

TABLE I-3

Past and Projected Employment at the Absaloka Mine

Year	Hourly Employees	Salaried Employees	Total Employees
1979	145	52	197
1980	134	51	185
1981	114	50	164
1982	87	45	132
1983	80	45	125
1984	80	40	120
1985	80	40	120
1986	80	40	120
1987	100	45	145
1988	140	50	190
1989	140	50	190
1990	175	55	230
1991	175	55	230
1992-2014	210	55	265
2015-2017	45	5	50

Source: David W. Simpson, General Manager of Absaloka Mine, written commun., November 19, 1982

DESCRIPTION OF THE EXISTING ENVIRONMENT

The analysis of Westmoreland's application and life-of-mine plans in this EIS covers a number of subjects, representing the "environment" of the Absaloka Mine today. This environment encompasses the resources, enterprises, services, facilities, and people that could be affected by the project.

GEOLOGY

Topography and Geomorphology

The application area generally lies east of the drainage divide between the East and Middle Forks of Sarpy Creek. The divide is a gently rolling surface, about 1/4 mile wide, drained by ephemeral tributaries to the two forks of Sarpy Creek. Topographic relief reaches a maximum of 300 feet within Tract III. Tributaries draining northward to the East Fork occur as vegetated coulees and vary in length up to about 2 miles. The southeastern corner of Tract III drains both north, toward the East Fork of Sarpy Creek, and southwest, toward the Middle Fork.

Evidence of accelerated erosion is generally absent. Dominant erosional processes active today include rainsplash, wind erosion, and sheet and rill wash. Significant channel erosion has not been observed, due largely to relatively coarse soils, low surface gradients, and good vegetative cover, all of which promote low runoff and high infiltration rates.

Structure and Stratigraphy

Regionally, Tract III is located in the northern part of the Powder River Basin. Strata in the area strike northwest and dip gently east and northeast 3 to 5 degrees. On Tract III, some local structural depressions are evident which trend northeast and appear to be related to faulting. The amount of offset in these structural features is minor, as evidenced in cuts now exposed in the mine. The most prominent feature identified in the Tract III area is a structurally low area in the northern portion of section 36 (Montana Department of State Lands, 1977).

The entire application area is underlain by the Tongue River Member of the Fort Union Formation, which contains all of the coal seams of economic importance in the area. The Tongue River Member mainly comprises variegated siltstone, mudstone, shale or claystone, and interbedded sandstone layers.

Two coal seams of economic importance in the Tongue River Member--the Robinson and the Rosebud-McKay--are preserved in this area. The lower of the two seams, the Robinson, is about 20 feet thick, and the higher, Rosebud-McKay, about 30 feet thick. Two stray seams, each 3 to 5 feet thick, are present locally above and below the Rosebud-McKay seam. All younger and stratigraphically higher coal seams have been removed by erosion (fig. II-1).

Shale and siltstone constitute most of the overburden and about half the interburden southeast of the structural low in section 36. Claystone or shale immediately underlies both coal seams. Sandstone forms most of the lower part of the member below the Robinson seam. Northwest of the structural low, sandstone layers are distributed more uniformly throughout the member, and underlie most of the land surface. There, too, the coal seams are immediately underlain by impermeable shale or claystone.

Coal Resources

Of the 825 million tons of coal underlying Tract III, Westmoreland Resources indicates that about 325 million tons comprise the minable reserve base. (This section is adapted from Westmoreland's permit application [Westmoreland Resources, 1983].). However, because areas with more than 150 feet of overburden cover are currently uneconomical to mine, the recoverable coal reserve is approximately 278 million tons. (The 20-year mine plan approved by the Department of the Interior in 1977 envisioned the extraction of 190.6 million tons by 1997, in addition to the 5.5 million tons mined through 1975 from the existing mine.)

Westmoreland now extracts between 3 and 5 million tons per year, although the mine can produce a maximum of 10 million tons per year. The coal is classed as subbituminous "B", has an average heating value of 8,450 Btu/lb, and contains 0.73 percent sulfur (Montana Department of State Lands, 1977).

Overburden

Overburden in the application area is typical of southeastern Montana. The average thickness of the overburden is 83 feet and the interburden 61 feet. (Overburden, as used in this text, is the material above the Rosebud-McKay coal seam, excluding the thin and often nonexistent Stray 1 seam; the interburden is defined as the parting material between the Rosebud-McKay coal seam and the Robinson seam, excluding the thin Stray 2 seam, which is also often nonexistent.)

Overall, the overburden has a slightly alkaline pH and is low in salinity and sodicity. The interburden also has an alkaline pH and is low in salinity. Unlike the overburden, however, the interburden is generally sodic. Textures of the overburden and interburden are usually clay loam to silty clay loam, but range from clay to loamy sand. Most trace element levels are low--an exception to this is molybdenum which is slightly elevated in a number of drill cores. Based on application area saturation percentages (water-holding capability), swelling clays do not appear to be present in significant quantities in either the overburden or interburden.

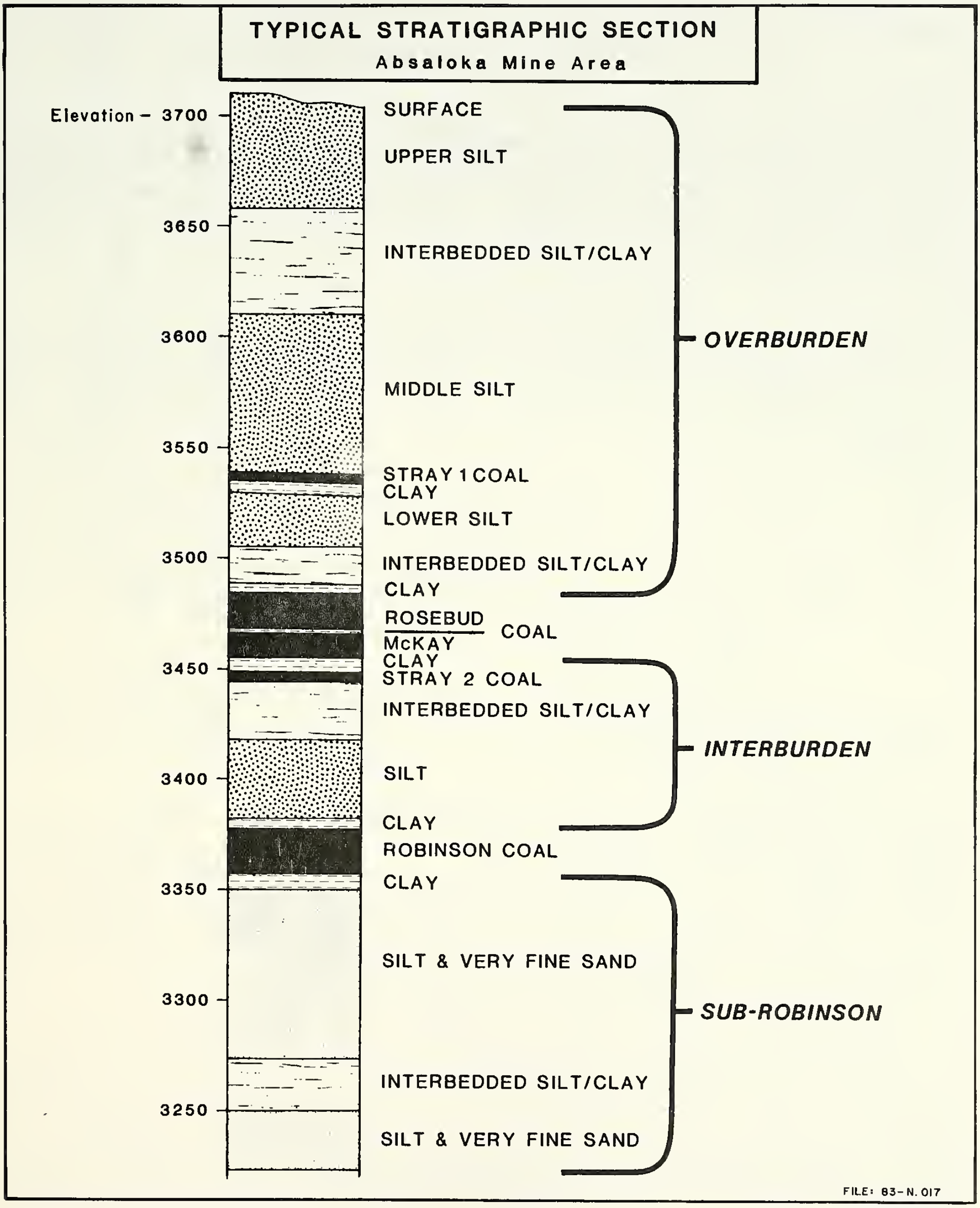


FIGURE II-1

Stratigraphy in the mine area is relatively uniform, made up of the Tongue River Member of the Fort Union Formation. The coal seams mined by Westmoreland include the Rosebud-McKay and Robinson.

HYDROLOGY

Surface Water

No perennial streams lie within Tract III. Surface water flows along interrupted ephemeral reaches within tributary coulees, and along short segments below several perennial springs. All surface water drains toward the East Fork, Middle Fork, or the main stem of Sarpy Creek (fig. II-2). East Fork and Middle Fork drain into the main stem of Sarpy Creek which, in turn, drains to the Yellowstone River.

Current mining operations are disturbing the watershed of all three forks of Sarpy Creek. However, because of Westmoreland's current drainage control plan and sedimentation impoundments, mining operations since 1974 have had no discernible impact on the surface water of the Sarpy Creek basins. The application and life-of-mine areas would both increase disturbances, primarily in the coulees that flow to the East Fork of Sarpy Creek.

The drainage area of the East Fork of Sarpy Creek above its confluence with Sarpy Creek is 81.6 square miles (about 52,000 acres). The application area contains 629 acres, or 1 percent, of the East Fork basin. The life-of-mine plan area contains another 2,096 acres, or about 0.8 percent, of the entire Sarpy Creek basin. Westmoreland would eventually disturb a total of 5,355 acres, or less than 2 percent of the total Sarpy Creek basin, although not all of this would be disturbed at the same time.

Records of the U.S. Geological Survey (Water Year Reports, 1974-82) indicate that the annual runoff from the Sarpy Creek drainage basin averages about 12 acre-feet per square mile (table II-1), although this varies greatly from year to year, sometimes by more than tenfold.

The most important surface water features within Tract III are the numerous springs located within several coulees that drain to the East Fork of Sarpy Creek (fig. II-2 and table II-2). At least 19 springs lie within the life-of-mine area. Nine springs occur in the application area (table II-3). All are the surface expression of a complex ground water system. The springs issue mainly from the Rosebud-McKay overburden, clinker, and alluvium and colluvium in the coulee bottoms. (See Ground Water.) Water from the springs is used heavily by livestock during the grazing season.

The springs (such as spring number 9; table III-3) at the heads of the coulees have small flows of less than 1 gallon per minute (gpm), whereas the two largest springs in North Coulee (numbers 8 and 12) discharge up to 18 gpm, depending upon the weather and season. Discharge rates of all springs have decreased since 1979, apparently due to drier climatic conditions. The smallest springs generally cease flowing during fall and winter, when the flows of the largest springs generally decrease. Only three of the springs, numbers 5, 8 and 12, are considered perennial water sources for livestock and wildlife.

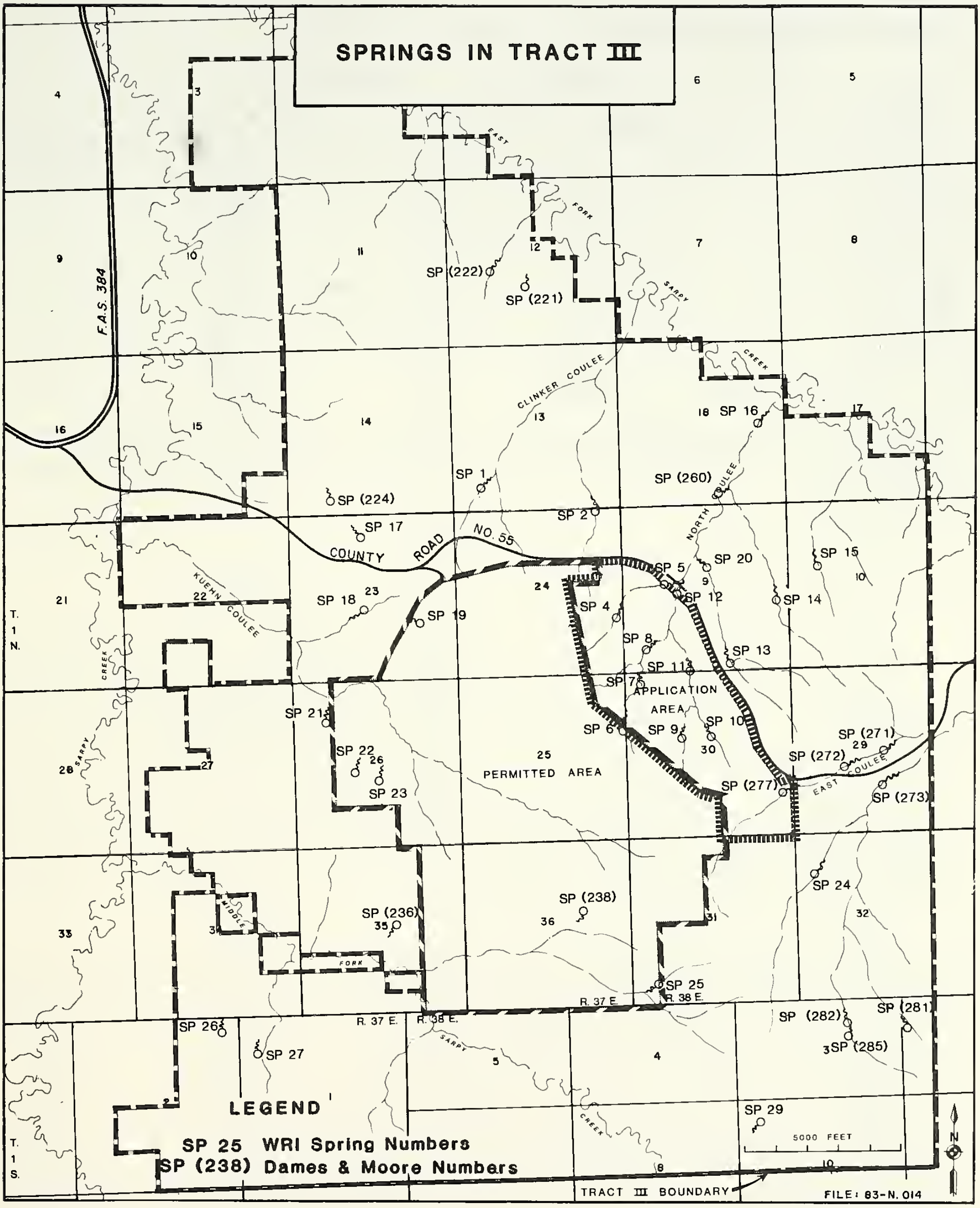


FIGURE II-2

Springs in Tract III often occur as isolated pools in coulee bottoms. The two largest springs in the application area are numbers 8 and 12.

TABLE II-1

Sarpy Creek Discharge

Water Year	Total Runoff[1]	Unit Runoff[2]
1974	2,010	4.4
1975	14,570	32.2
1976	1,580	3.5
1977	1,870	4.1
1978	10,450	23.1
1979	11,780	26.0
1980	1,450	3.2
1981	1,100	2.4
1982	4,320	9.5
9-Year Average	5,459	12.1

Source: U.S. Geological Survey Water Year Reports, Montana, 1974-1982.
Note: Measured near Hysham, Montana. Drainage area is approximately 453 square miles.

[1] Values in acre-feet.

[2] Values in acre-feet of runoff per square mile of drainage area.

The springs occur primarily as isolated discharges or seeps along coulee bottoms where the underlying water table is close to the ground surface. Most have been improved by ranchers to make the water more readily available to livestock. The improvement generally has been by excavating in the coulee bottoms to intercept the ground water table. The springs flow for short, variable distances down the coulee before the water infiltrates into the coulee bottom. No evidence of continuous, active surface water channels exists anywhere in the coulee systems draining northeast from the application area. This indicates that channeled runoff in this vicinity contributes little to the flows of the East Fork of Sarpy Creek. Table II-3 provides a brief description of the nine springs within the application area.

A review of 176 townships covering the Fort Union coal region of southeastern Montana indicates that the townships of Tract III probably do not contain a greater density of springs, or springs of significantly better water quality, than do other comparable areas within the region (Westech, 1977). Water quality analyses of samples taken from spring flows in Tract III indicate that the water quality is about average for southeastern Montana.

Areas of high spring density within the region tend to be located next to uplands, such as the Wolf and Little Wolf Mountains, and in the Ashland District of Custer National Forest. This suggests that the scale of comparison is the single most important factor in any statement concerning the density of springs in Tract III. The density of springs per unit area in Tract III is possibly significantly greater than in eastern Montana as a whole.

TABLE II-2

Selected Data for Tract III Springs

Spring number[a]	Water Source[b]	Elevation (feet)[c]	Measured or Estimated flow(gpm)	Specific Conductance (umhos/cm)[d]
1	rmcl	3,430	0-7.0	1,900-2,500
2	rmcl	3,410	0-2.3	1,860-2,250
4	Ttrl	3,455	0-5.4	1,000-2,480
5	rmcl	3,440	0-3.8	1,850-5,160
6	Ttrl	3,560	0-0.8	1,090-2,130
7	rmcl	3,465	0-3.8	1,350-3,710
8	rmcl	3,445	0-14.1	1,150-3,060
9	Ttrl	3,550	0-0.1	1,270-1,510
10	Ttrl	3,510	0-2.5	1,020-1,790
11	Ttrl	3,460	0-2.2	1,630-2,530
12	Q	3,405	0-18.0	1,190-2,150
13	Ttrl	3,468	0-2.9	908-4,000
14	Ttrl	3,460	0-1.4	1,220-1,280
15	Ttrl	3,460	0	1,050-1,080
16	Q	3,320	0	2,800
17	rmcl	3,450	0	3,600
18	rmcl	3,430	0.05-0.38	2,100
19	rmcl	3,450	0	1,200-2,900
20	Q	3,400	0	1,360
21	rmcl	3,400	0-9.38	4,400
22	rmcl	3,480	0-0.04	3,300
23	rmcl	3,540	0	1,900
24	Ttrl	3,510	0-0.58	1,320-2,270
25	Ttrl	3,540	0	780-848
26	U	3,540	0	1,160
27	U	3,470	0-0.03	850
29	Ttrl	3,560	0	1,060
221	rmcl	3,430	0	1,060
222	Q	3,365	0-0.008	6,000
224	rmcl	3,420	0-1.1	4,300
236	U	3,435	0-1.5	2,600
238	Ttrl	3,477	0-0.2	1,220-1,640
260	Q	3,360	0-5.8	2,480
261	Q	3,440	0-0.93	
271	Ttrl	3,460	0-0.14	1,400-1,670
272	Ttrl	3,470	0-0.13	1,340
273	Ttrl	3,465	0	2,800
277	Ttrl	3,520	0-1.7	1,670-2,320
281	Ttrl	3,650	0-0.4	2,200
282	Ttrl	3,575	0	1,020
285	Ttrl	3,615	0-2.5	2,800

Source: Montana Department of State Lands, 1979; Westmoreland Resources, 1983.

[a] Spring number indexed to locations shown on fig. II-2

[b] Source: Q=Quaternary alluvium or slope wash; Ttrl=Tongue River member above Rosebud-McKay coal; rmcl=Rosebud-McKay clinker; U=undetermined.

[c] Estimated from U.S. Geological Survey and Westmoreland Resources maps, 1983.

[d] Values shown are lab measurements.

TABLE II-3

Characteristics of Springs Affected by Mining in the Application Area

Spring Number	Description
4	Occurs in the coulee bottom as a small pond behind a small impoundment structure.
5	Occurs in a small headcut in the coulee bottom and from the north bank. Improvements have been made to allow flow to fill a stock tank, which apparently is a perennial water source.
7	Occurs as a large shallow depression behind a small constructed impoundment. Contained water in 1979, but was dry in August 1983.
8	Discharges partially from a small stand of trees in the coulee bottom and from the coulee's west bank. Two ponds have been constructed to provide an apparent perennial water source.
9	Occurs as seepage from the coulee bottom. A minor impoundment has been built below the spring. It is dry most of the time.
10	Occurs as seepage from the coulee bottom and has been improved by installing several catchments of approximately 50 gallons, which frequently contain water even when the coulee bottom is dry and seepage is not observed.
11	Discharges from a headcut into a small pool and then to several large ponds down the coulee. Contained water in 1979, but was dry in August 1983.
12	The largest spring in North Coulee, it occurs from a headcut in the coulee bottom. A pool below the headcut has been deepened for stock improvement. It is a perennial water source just outside the application area.
261	Occurs as seepage in the coulee bottom.
277	Occurs as seepage from the bottom of East Coulee. It is in the associated disturbance part of the application area, which is not proposed for mining.

Note: Refer to fig. II-2 for spring locations.

Part of the combined perennial flow of some of the springs and the associated ground water flow within the coulees ultimately contributes to ground water flow within the East Fork of Sarpy Creek valley. Data provided by Westmoreland, however, suggest that most of this water is consumed by evapotranspiration before it ever reaches the East Fork.

The drainage that would be most affected by mining is North Coulee, a tributary to East Fork of Sarpy Creek. Data submitted by Westmoreland suggest that surface water from North Coulee contributes less than one percent of the flow in the East Fork of Sarpy Creek. The predominance of clinker deposits in the coulee are not conducive to providing surface runoff.

Field observations and data provided by Westmoreland indicate that nearby portions of the Sarpy Creek system may meet criteria for alluvial valley floors under Montana and federal strip mine laws. No areas identified as potential alluvial valley floors are included within the application or life-of-mine areas.

Ground Water

Several separate ground-water-bearing zones lie within the application area: alluvium and colluvium within the coulees, Rosebud-McKay overburden, Rosebud-McKay clinker, Rosebud-McKay coal, Robinson coal, and sub-Robinson aquifer. Other aquifers, including the Madison Limestone from which Westmoreland gets most of its industrial purpose water, lie at greater depths. Ground-water-bearing zones and aquifers stratigraphically below the Robinson coal have not been affected by mining.

The most important ground-water-bearing units in the immediate mine vicinity are the alluvium and colluvium underlying the coulees draining the mine area (fig. II-2), the Rosebud-McKay overburden, and the Rosebud-McKay clinker. These units support the numerous springs within the coulees draining the mine area. The coulees transmit both ground and surface water toward the Middle and East Fork of Sarpy Creek. The coulees receive recharge by at least three primary means. Point source recharge to the coulees occurs from springs issuing from both the Rosebud-McKay overburden and from adjacent clinker. Less direct but possibly equally as important recharge occurs by subsurface flow from both the overburden and the clinker. The most important means of recharge to the coulees appears to be snowmelt. The relationships between ground and surface water flow within the coulees results in a water table close to or at ground surface.

In Tract III the Rosebud-McKay overburden comprises three separate parts, termed by Westmoreland Resources as the upper, middle, and lower silts (fig. II-1). The middle and lower silts underlie most of the northern and western portions of Tract III. The upper silt appears to be present only at higher elevations in the southeastern quarter of the tract. Although termed the upper silt, this unit is in places a fine-grained sandstone.

The overburden's hydrogeologic significance increases toward Tract III's southeastern corner. Recharge to the overburden within the vicinity of proposed mining area comes from local precipitation. Ground water movement within the overburden is generally away from the local ground water divide. The divide nearly matches the surface water divide between the East and Middle Forks of Sarpy Creek.

The overburden discharges laterally to adjacent Rosebud-McKay clinker, to springs within coulees draining the divide, and to a much lesser extent, to underlying Rosebud-McKay coal. The overburden is the sole ground water source for some of the small springs in the heads of coulees that flow to the Middle and East Forks of Sarpy Creek and is the source of some of the ground water moving down the coulees.

Another ground-water-bearing unit of importance is the Rosebud-McKay clinker. Part of the clinker unit underlies the life-of-mine area east of the drainage divide between the Middle and East Forks of Sarpy Creek. The clinker receives recharge at high rates from direct precipitation and snowmelt and, probably in lesser amounts, from adjacent overburden and unburned Rosebud-McKay coal. The clinker discharges through springs located within the coulees and by direct subsurface flow to the coulees. This unit probably contributes to much of the water flowing within North and Clinker Coulees.

At the upper end of the coulees, the base of the clinker underlies the surface of the alluvium and colluvium. Lower in the coulees, the clinker base is exposed, running along the coulees' sides, where vegetation demarcates the unit. This occurs because the coulee bottom's gradient is greater than that of the base of the clinker.

Because clinker is highly transmissive and allows ground water flow at relatively high rates, water storage in large amounts is unusual. This is particularly the case with small, free-draining clinker areas that have sharp contacts with underlying, less permeable bedrock units. The two largest springs in the main coulee system (numbers 8 and 12--see fig. II-2) probably receive a significant portion of their recharge from a small clinker area adjacent to the west bank of North Coulee. This conclusion is based partially on drilling in this small clinker area by Westmoreland in 1979. Drilling results revealed that the burn of the clinker is not complete: Much of the Rosebud-McKay coal seam is present beneath the clinker, although in an altered, weathered condition. These two large springs are also recharged by adjacent, upgradient alluvial and colluvial deposits.

The water-bearing coal seams within the mine area--the Rosebud-McKay and Robinson seams--allow little ground water movement through the mine area, especially when compared to the overburden, the clinker, or the unconsolidated coulee deposits. Collectively, the Rosebud-McKay and Robinson seams are of little importance to total ground water movement within the area.

North Coulee is the primary tributary to the East Fork of Sarpy Creek to be affected by proposed mining activities. Data presented in Westmoreland's application indicate that ground water flow in the coulee totals 10.3 acre-feet per year. In comparison, total ground water flow in the East Fork of Sarpy Creek alluvium has been calculated at 102 acre-feet per year. The Robinson coal, which subcrops to the East Fork alluvium contributes an estimated 0.4 acre-feet to the system annually.

Ground water within the application area is potable and suitable for most purposes. Numerous ground water quality data for the area have been reported (U.S. Department of Interior, 1976 and 1977; Montana Department of State Lands, 1977 and 1979; Westmoreland Resources, 1983). The location of much of Tract III on a drainage divide and the adequacy of good quality surface water supplies have resulted in relatively few wells in the immediate mine area (fig. II-3 and table II-4).

SOILS

The soils of the disturbance area vary in their depth, texture, color, profile morphology, and coarse fragment content. This diversity reflects the variability of topography, parent materials, vegetation, and past land uses.

A total of eight soil series and one unnamed soil type have been identified and placed into 11 mapping units in the proposed disturbance area. For ease of discussion, the soil mapping units have been divided into three major soil groups based on similarities in parent material and topographical position:

--Residual Soils
--Depositional Soils
--Drainageway Soils

The locations of these general soil groups within the disturbance area are shown on figure II-4. For a complete listing of the mapping units proposed for disturbance, as well as the amount of soil by unit proposed for salvage, see table III-2 in chapter III, Soils.

Residual Soils

The residual soils group covers about 84 percent of the disturbance area. The group consists of moderately deep and shallow soils that are developing in place over sandstone, shale, or porcelanite (clinker). The soils in this group are mildly alkaline and textures range from clay loam to sandy loam. Most of these soils contain coarse shale, siltstone, or sandstone fragments that increase in number with depth.

Common vegetation growing on the loam and clay loam soils in this group includes needle-and-thread, western wheatgrass, sideoats grama, broom snakeweed, and fringed sagewort. Plants associated with the sandier soils of this group include prairie sandreed, dryland sedges, silver sagebrush, green sagewort, and yucca. Within this group, the Cushman and Spearman soils formed from both shale and sandstone, the Thedalund soils formed from shale and siltstone, the Nelson soils formed from sandstone, and the Wibaux soils formed from porcelanite.

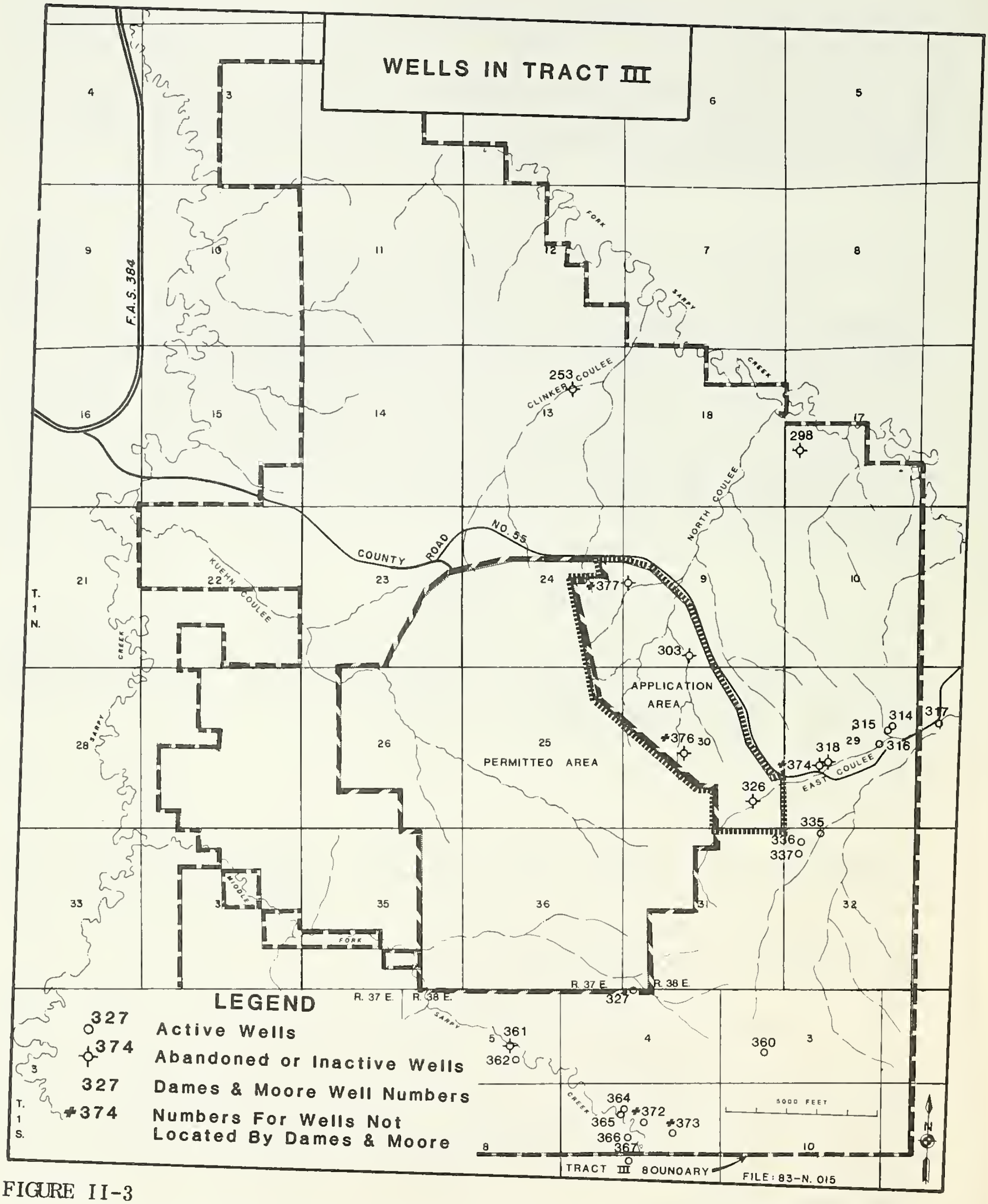


FIGURE II-3

Few wells have been drilled in Tract III, owing to the many springs available for high quality water.

TABLE II-4

Selected Data for Domestic and Stock Wells
In the Vicinity of Tract III

Well No.	Location	Aquifer of Completion	Present or Former Use	Status
253	01N37E13ACAB	Alluvium	Stock	Abandoned
298	01N38E17CBCA	Sub-Robinson	Household, Stock	Abandoned
303	01N38E19CDDC	Rosebud-McKay	Stock	Abandoned
306	01N38E27BBAB	Parting between Rosebud and McKay	Household, Stock	Abandoned
314	01N38E29ACDB	Rosebud-McKay Coal	Household	In use
315	01N38E29ACDB	Rosebud-McKay Coal	Household	In use
316	01N38E29ACCD	Alluvium	Stock	In use
317	01N38E28BDAD	Alluvium	Stock	In use
318	01N38E29CABC	Rosebud-McKay Coal	Stock	Abandoned
326	01N38E30DDBC	Overburden	Household	Abandoned
327	01N38E31CCCC	Rosebud-McKay Coal	Stock	In use
335	01N38E32BBAA	Alluvium	Stock	In use
336	01N38E32BBBD	Rosebud-McKay Coal and Underlying Interburden	Household	In use
337	01N38E32BBCA	Sub-Robinson	Stock	In use
360	01S38E03CDBC	Rosebud-McKay Coal	Stock	In use
361	01S38E05DCAB	Sub-Robinson	Household	Abandoned
362	01S38E05DCAD	Alluvium	Stock	In use
364	01S38E09BADB	Rosebud-McKay Coal	Household	In use
365	01S38E09BACD	Rosebud-McKay Coal	Household	In use
366	01S38E09BDAC	Rosebud-McKay Coal	Stock	In use
367	01S38E09BDDC	Rosebud-McKay Overburden	Stock	In use
372	01S38E09ABBC	Rosebud-McKay Coal	Stock	In use
373	01S38E09ACAD	Sub-Robinson	Household	In use
374	01N38E29CBAD	Rosebud-McKay Overburden	Household	Abandoned
375	01N38E22CCCC	McKay Coal	Household	In use
376	01N38E30CAAB	Overburden	Household	Abandoned
377	01N38E19BCCC	Rosebud-McKay	Stock	Abandoned

Source: Westmoreland Resources (1983).
Note: For well locations, see fig. II-3.

Depositional Soils

The depositional soils group covers about 14 percent of the disturbance area. The group consists of deep soils that are developing in alluvium (water-deposited material) and colluvium (material which has moved downhill and accumulated at the base of slopes as a result of gravity). Textures range from clay loam to sandy loam. Common vegetation found on the medium textured

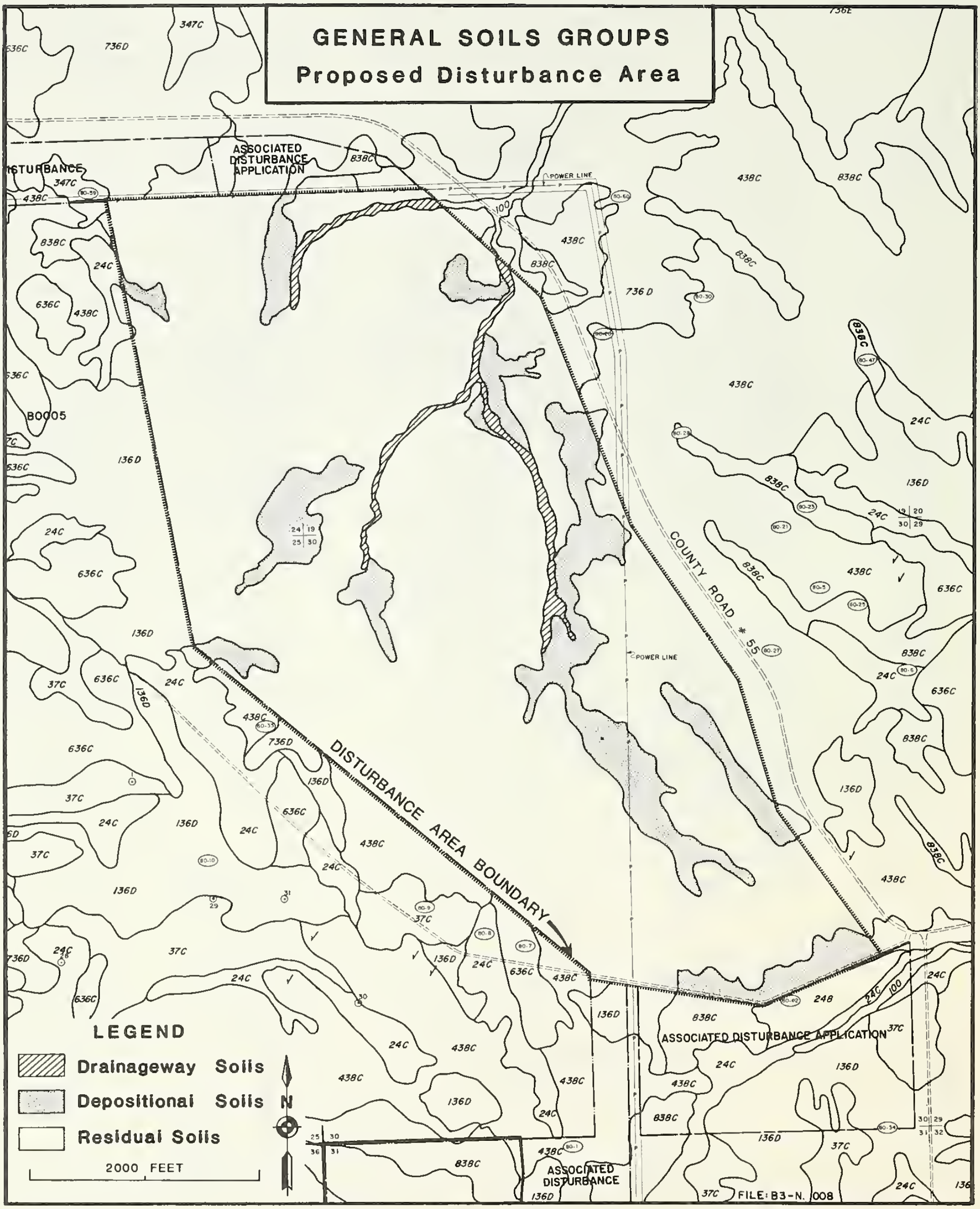


FIGURE II-4

Three major groups of soils lie in the 573 acres Westmoreland would disturb in the application area.

soil of this group includes blue grama, needle-and-thread, and western wheatgrass. Vegetation common to the coarser soils of this group includes little bluestem, green sagewort, prairie sandreed, and sideoats grama. Within this group, the Alice soils are forming mostly from sandy colluvium and some sandy alluvium, and the Fort Collins and McRae soils are forming in loamy and clayey alluvium.

Drainageway Soils

The drainageway soils group covers about 2 percent of the disturbance area. This group consists solely of the mapping unit called "Aquolls and Aquents." These soils are found only in drainageways with ground water seepage. The soils are stratified loam, sandy loam, silt loam, and clay loam. Weathered coal particles are common in some strata and are responsible for the black color at any depth in the soil profile. At some sites permanent water table fluctuates between the surface and a depth of 5 feet. The single mapping unit in this soil group is seldom greater than 100 feet wide. It includes the flat bottom of the drainageway and the short, steeply sloping banks that are not wet, but support wetland vegetation.

Prime Farmland Soils

Prime farmland consists of soils with favorable physical and chemical characteristics and an adequate moisture supply. (See ARM 26.4.301(49) and Federal Register 7 CFR 657.) Operators disturbing prime farmland must follow special handling and reclamation procedures.

In the application area, no developed water supply that is dependable and of adequate quality for irrigation exists. Therefore, none of the soils qualify for prime farmland designation.

VEGETATION

The proposed disturbance area is used primarily for livestock grazing (Montana Department of State Lands, 1979). Heavily grazed areas are dominated by increaser species. Included among the increasers are most shrubs and forbs and some grasses that increase in relative abundance under continued heavy grazing. Rangeland in good condition is indicated by an abundance of decreaser species. These are usually grasses which decrease in relative abundance under continued heavy grazing. Invader species (species not present in stable, mature vegetation communities) are common on disturbed lands.

The vegetation of the disturbance area (table II-5) can be classified into six types: grassland, ponderosa pine forest, riparian, deciduous tree and shrub, agricultural, and disturbance (Westmoreland Resources, 1983, bk. H, vol. 2). The grasslands can be subdivided based on range sites (U.S. Soil Conservation Service, 1971). Other types can be subdivided based on dominant vegetation or land use. No threatened or endangered plants have been found on the disturbance area.

Grassland makes up about 31 percent of the disturbance area (table II-5). The silty range subtype, more accessible to cattle than other sites, is dominated by increaser species. The sandy subtype, usually found on upper slopes, is in better condition. The shallow and thin breaks subtypes, generally found along ridges with minimal soil development, have highest range conditions. Overall, the range condition of the disturbance area is fair, based on U.S. Soil Conservation Service methods.

TABLE II-5

Vegetation Communities in Proposed Disturbance Area

Vegetation Type	Acres	Percent[1]	Associated Subtypes	Acres	Percent[1]
Grassland	176	31	Silty	89	16
			Sandy	80	14
			Shallow	2	--[2]
			Thin Breaks	5	1
Ponderosa Pine Forest	184	32	Open Canopy	122	21
			Closed Canopy	62	11
Riparian[3]	4	1	Wetland	4	1
Deciduous Tree and Shrub	24	4	Snowberry-Rose	20	3
			Shrub Thicket	4	1
Agricultural	154	27	Alfalfa Hay	88	15
			Small Grains	66	12
Disturbance	31	6	Disturbed Grassland	26	5
			Miscellaneous	5	1
TOTAL	573	100		573	100

Source: Westmoreland Resources, 1983, bk. H, ex. 7, p. 2.

[1] Percentages rounded to nearest whole number. Column 6 total rounded to 100 percent.

[2] less than 0.5 percent.

[3] Marsh and overflow subtypes were not included in vegetation mapping due to their limited acreages.

Increaser grasses common to all grassland range sites include western wheatgrass, penn sedge, needle-and-thread, and prairie junegrass. A decreaser grass found on all range sites is sideoats grama. Other common decreaser grasses are bluebunch wheatgrass, little bluestem, and prairie sandreed. (See app. G for scientific names.)

The primary invader species in grasslands is Japanese brome, which grows on sandy and silty range sites. Grassland forbs include western yarrow, Hood's phlox, and broom snakeweed. Shrubs growing in grasslands include yucca, skunkbush sumac, snowberry, and silver sage. These shrubs visually dominate some sites, such as drainages and swales. Scattered ponderosa pines are also found within grasslands.

Ponderosa pine grows primarily on northern exposures, where the soil contains more moisture. Forests of pine, covering 32 percent of the disturbance area, are divided into two subtypes: closed canopy (greater than 75 percent canopy coverage) and open canopy (25 to 75 percent canopy coverage). Mean densities of ponderosa pine are estimated at 1,320 trees per acre in the closed-canopy subtype and 117 trees per acre in the open canopy subtype. Both subtypes have a sparse understory because a covering of pine needles and limited sunlight penetration discourage other plant growth. Limited amounts of Idaho fescue, green needlegrass, and bluebunch wheatgrass, however, do provide cattle forage. Snowberry, skunkbush sumac, and various forbs also grow in the understory.

Riparian vegetation grows in coulee bottoms and around ponds (Table II-5). Slough sedge, a decreaser species, dominates the wetland subtype and accounts for their good range condition. Although not mapped because of their limited acreage, marsh and overflow subtypes also occur in the disturbance area. Marshes, consisting primarily of cattails and bulrush, are found near surface water. Brief flooding during spring encourages the growth of western wheatgrass, basin wildrye, and big bluestem in the overflow subtype.

The deciduous tree and shrub type covers only 4 percent of the disturbance area. (Although limited, the type functions as important wildlife habitat. See Wildlife.) The trees and shrubs usually grow along coulee bottoms. In the snowberry-rose subtype, snowberry normally makes up over 60 percent of the vegetative cover. Bluegrass is the most commonly associated grass. This subtype is often a riparian subtype that has deteriorated due to heavy grazing. In the shrub thicket subtype of the deciduous type, an overstory of hawthorn, plum, chokecherry, and buffaloberry grows with an understory of snowberry and rose. Green ash and box elder are occasionally intermixed.

Agricultural land covers about 27 percent of the disturbance area. Alfalfa grows in the southern end of the area. Grain fields, principally winter wheat and barley, occur in the north. (See Land Use for production figures.)

Disturbed grasslands, including seeded rangeland and old agricultural fields, make up most of the disturbance type (table II-5). In addition, the type contains gravel pits, buildings, and stock ponds.

Vegetation in the life-of-mine area is similar to vegetation within the disturbance area. As a proportion of the entire life-of-mine area, grassland makes up an estimated 56 percent; agricultural, 22 percent; ponderosa pine, 17 percent; and deciduous tree and shrub, 5 percent (Westmoreland Resources, 1983, bk. G, ex. G-15, pl. 1).

AQUATIC ECOLOGY

Aquatic populations within the mine plan area are limited in diversity and number. This reflects the small amount of aquatic habitat--small springs and ponds only. A qualitative benthic macroinvertebrate survey was conducted in

1981 (Westmoreland Resources, 1982, bk. G, vol. 3, ex. G-14). Most organisms collected were dipterans (true flies), hemipterans (true bugs), or coleopterans (beetles). (See app. B for a list of the invertebrates collected.) None of these organisms is threatened or endangered. No algae samples were collected. No fish were found.

An aquatic macroinvertebrate and fish survey was conducted in Sarpy Creek and East Fork Sarpy Creek during 1976 by the Cooperative Fishery Research Unit at Montana State University (Westmoreland Resources, Inc. 1980, bk. I, vol. 2, ex. I-17). Samples were collected at eight sites. Diptera was the most numerous group present; the families Tendipedidae and Simuliidae were usually dominant. (Organisms were identified only to the family level.)

The aquatic habitat of Sarpy Creek, particularly the upper reaches near the minesite, is primarily suited for nongame fish. Nineteen species of fish were identified. White sucker and lake chub were the most numerous.

WILDLIFE

The Tract III area's diverse topography and complex mosaic of vegetation types provides excellent wildlife habitat. (This section, Wildlife, is based on Westmoreland's annual wildlife surveys conducted since 1976 within Tract III [1983, bk. G, vols. 2 and 3].) Grassland is the most prevalent habitat type in Tract III and in the life-of-mine area (table II-6). The ponderosa pine type, making up about 42 percent of habitat coverage, is the most predominant type in the proposed disturbance area.

Nine rock outcrops within the life-of-mine area provide wildlife cover and nest sites. In the disturbance area, three ponds (one apparently perennial, two seasonal), one seep (seasonal), and one well with a stock tank (apparently perennial) supply water and may serve as waterfowl habitat. Wildlife also use a perennial pond bordering the northeast corner of the disturbance area. (See Hydrology, Surface Water.) Six water sources for wildlife have been identified in the life-of-mine area.

Big Game

The big game species inhabiting Tract III are mule deer, white-tailed deer, and pronghorn antelope. (See app. C for scientific names of wildlife species.) Mule deer are the most abundant and widely distributed species. In 1981 distribution surveys, 26 were sighted in the proposed disturbance area and 63 in the life-of-mine area.

Mule deer use a variety of habitat types to satisfy seasonal requirements (table II-7). The ponderosa pine type provides thermal cover in winter and shade in summer. It is also used for fawning. Agricultural lands, especially during fall, provide forage. The silver sagebrush type serves as transitional habitat between winter and summer habitats. Snowberry and shrub thicket types provide fawning and resting cover and succulent forage during dry months.

TABLE II-6

Wildlife Habitat Types
Tract III and Mining Areas

Habitat Type	Percent of Area[1] Tract III[2]	Disturbance[2]	Life-of-Mine[3]	Comments
Grasslands	27	25	56	Native and disturbed
Ponderosa pine	22	42	17	All coverage classes
Agricultural	11	27	22	Grain and hay fields
Skunkbush sumac	11	0	--[4]	Skunkbush over grass
Silver sagebrush	10	3	--[4]	Silver sage over grass
Snowberry	5	2	2	Often in coulees
Big sagebrush	5	0	--[4]	Big sage over grass
Shrub thickets	3	1	3	In coulees and creeks
Mine area	6	0	0	Active mining areas
Reclaimed	2	0	0	Mined and reclaimed

Note: Criteria used in classification of wildlife habitat types differed from criteria used for vegetation communities.

[1] Rounded to nearest whole number.

[2] Percentages from Westmoreland, 1983, bk. G.

[3] Dot count method used to estimate percentages from Westmoreland's ex. G-15, pl. 1 (1983).

[4] Less than 1 percent.

Although these thickets make up only 8 percent of Tract III, they receive relatively heavy use. Reclaimed areas (lands planted in wheat, grasses, and legumes that are ungrazed by cattle) are used mostly in winter and spring for forage.

Data indicate that the mule deer in Tract III have high reproductive rates. In 1978 the fawn:doe ratio reached 118:100. Fawn:doe ratios have since declined, but the 1982 ratio of 90:100 is still considered high.

White-tailed deer are observed sporadically in all seasons. In 1981 distribution surveys, 3 deer were sighted in the application area and 26 in the life-of-mine area. Habitat use patterns resemble those of mule deer (table II-7). Whitetails, however, rely more heavily on the shrub thicket type for fawning, escape, and resting cover. Whitetails also forage more often in agricultural lands. The Tract III whitetail population has apparently declined since 1976. Whitetail observations over the past few years have been insufficient for calculation of fawn:doe ratios.

Good pronghorn habitat contains significant amounts of sagebrush (Severson and May, 1967; Amstrup 1978). The scarcity of sagebrush types in Tract III corresponds with the low number of pronghorn observations. Pronghorn were not observed in the fall and winter of 1981 on Tract III. Only seven were sighted during distribution surveys the rest of the year on the disturbance and life-of-mine areas. Most pronghorn have been observed in

TABLE II-7

Big Game Habitat Use in Tract III
By Season, 1981

Species	Habitat Type	Percent of Animals Observed in Type[1]			
		Winter	Spring	Summer	Fall
Mule deer[2]	Grassland	16	23	11	5
	Ponderosa pine	34	16	31	18
	Agricultural	4	8	22	28
	Skunkbush sumac	4	4	8	5
	Silver sagebrush	7	22	8	25
	Snowberry	5	3	3	3
	Big sagebrush	2	1	0	1
	Shrub thicket	11	5	17	12
	Mine area	3	3	1	2
	Reclaimed	13	15	0	1
White-tailed deer[3]	Grassland	4	13	33	0
	Ponderosa pine	22	23	14	0
	Agricultural	57	8	5	100
	Snowberry	0	8	14	0
	Shrub thicket	17	38	33	0
	Others	-	13	0	-
Pronghorn antelope[4]	Grassland	-	62	100	-
	Ponderosa pine	-	16	0	-
	Shrub thicket	-	11	0	-
	Others	-	13	0	-

[1] Rounded to nearest whole number.
[2] Number observed (including incidental sightings): winter, 460; spring, 513; summer, 195; fall, 547.
[3] Number observed (including incidental sightings): winter, 72; spring, 40; summer, 21; fall, 1.
[4] Number observed (including incidental sightings): spring, 90; summer, 44.

grasslands in the eastern and southeastern portions of Tract III (table II-7). Their use of wooded areas, probably for fawning, is uncharacteristic of the species (Einarsen, 1948; Rouse 1959). The low 1981 fawn:doe ratio of 31:100 reflects the poor quality of habitat.

Other Mammals

Coyotes have been frequently sighted in Tract III in grasslands and agricultural habitat types. Other predators observed include bobcats, badgers, long-tailed weasels, raccoons, and striped skunks. Porcupines, muskrats, white-tailed jackrabbits, desert cottontails, least chipmunks, and red squirrels also inhabit Tract III. The life-of-mine area includes a 3-acre black-tailed prairie dog town.

In 1981, Westmoreland placed small mammal traplines in ponderosa pine, grassland, agricultural, reclaimed, and coulee bottom habitat types. Ten traplines were within the proposed mining areas. Deer mice, trapped in all habitat types, constituted 79 percent of the total catch. Prairie voles, Wyoming pocket mice, meadow voles, and masked shrews were also trapped. Most captures were made in the dense cover of the coulee bottom and reclaimed types. The sparse understory of ponderosa pine forests accounted for only 2 percent of the catch.

Upland Game Birds

Flocks of 40 to 50 Merriam's wild turkeys have been commonly observed in Tract III. Turkeys have been sighted in both the disturbance and life-of-mine areas. Ponderosa pine is the most important turkey habitat type in most seasons. Turkeys roost in pines and feed on pine seeds. Open, grassy areas are used during spring courtship. Turkeys also feed in reclaimed and agricultural types. Dense coulee bottom vegetation supplies brood-rearing, feeding, and escape cover.

Seven sharp-tailed grouse dancing grounds, used by 66 courting males in 1982, lie within Tract III. The three grounds in the life-of-mine area were attended by 28 males the same year. Sharptails feed in grassland, agricultural, and reclaimed types near dancing grounds. Shrub thickets provide escape and resting cover.

Ring-necked pheasants inhabit lowlands near Sarpy Creek and its tributaries. The life-of-mine area contains about 2 miles of pheasant habitat along the East Coulee.

Waterfowl

Mallards, blue-winged teal, green-winged teal, and gadwalls nest within Tract III. Other waterfowl observed include shovelers, American widgeons, and Canada geese. Only mallards have been recorded in the proposed mining area.

Raptors (Birds of Prey)

Golden eagles, prairie falcons, great-horned owls, and screech owls reside year-round in Tract III. American kestrels, northern harriers, and red-tailed hawks have been commonly observed in summer. One great-horned owl pair nests in the disturbance area and another nests in the life-of-mine area. A red-tailed hawk pair nests in the life-of-mine area, less than 0.25 miles east of the disturbance area. Another red-tailed hawk nest and a northern harrier nest lie between the southern and eastern portions of the life-of-mine area.

Songbirds

Songbird surveys were conducted in 1981 in the proposed mining areas. Coulee bottom, ponderosa pine, grassland, and disturbed grassland types were sampled. Coulee bottoms had the most diverse populations with 33 species counted in the East Coulee. Common coulee bottom species included robins, yellow warblers, and rufous-sided towhees. Only western meadowlarks and vesper sparrows were observed in grasslands, while no observations of any songbirds were made in disturbed grasslands. Red crossbills were the most abundant ponderosa pine species.

Reptiles and Amphibians

Prairie rattlesnakes, gopher snakes, yellow-bellied racers, western painted turtles, spadefoot toads, and western toads were recorded in 1982 in Tract III.

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (W. Brewster, pers. commun., October 17, 1983) lists three endangered species that may occur in the disturbance area: the black-footed ferret, the bald eagle, and the peregrine falcon. Black-footed ferrets are usually associated with prairie dog towns. Although the town in the life-of-mine area has not been thoroughly searched, this endangered species has not been observed (M. Mitchell, Westmoreland Resources, pers. commun., 1983). Migrating bald eagles and peregrine falcons have been occasionally observed over Tract III. No nests or concentration areas have been found.

CLIMATE

The Sarpy Creek area has a climate typical of the semiarid northern Great Plains. Precipitation is low but variable and falls primarily during late spring and early summer. Daily and seasonal temperatures range widely. Surface humidity is low. Wind speeds are moderate.

Precipitation

Total annual precipitation in the area averages between 14 and 15 inches (Toy and Munson, 1978). At the mine itself, during 1976 to 1981, the annual average precipitation was 14.0 inches and ranged from 12.6 to 24.2 inches (Westmoreland Resources, 1983, bk. F, vol. 1-3). About 43 percent of the total precipitation fell from April through June. Annually, precipitation is expected to fall on 95 days. Snowfall amounts total 30 to 50 inches per year (U.S. Department of Interior and Montana Department of State Lands, 1980, p. II-22). Recurrence intervals for 1-, 6-, and 24-hour precipitation events (rainstorms, snowfalls) are presented in table II-8.

TABLE II-8

Maximum Precipitation Expected
At the Absaloka Mine During Various Time Intervals

Length of Event (hours)	Number of years considered 2	5	10	25	50	100
	Amount of Precipitation (Inches)					
1	0.7	0.9	1.1	1.3	1.5	1.7
6	1.0	1.3	1.6	2.0	2.2	2.4
24	1.4	2.0	2.4	3.0	3.4	3.8

Evaporation

Evaporation was measured with a Class A evaporation station at the mine office. The mean annual evaporation for the period May through September was about 33.4 inches from 1976-1981 (Westmoreland Resources, 1983, bk. F, vol. 1-13).

Humidity

During 1981, relative humidity averaged about 50 percent, being highest during the cooler months and lowest during the warmer months.

Temperature

Average temperatures range from 45 to 50° F. July and August are the hottest months and January and February are the coldest months. The potential growing season, based on the freeze-free period of 100 to 105 days, is effectively terminated during mid-summer when drought-induced dormancy of vegetation occurs (Toy and Munson, 1978).

Winds

Wind speeds average 6 to 7 miles per hour. Calm periods are rare, occurring less than 1 percent of the time (Westmoreland Resources, 1983, bk. F, vol. 1-3). There is a near even distribution of winds, blowing from all directions.

The regional EIS on the Northern Powder River Basin (U.S. Department of the Interior and Montana Department of State Lands, 1978) and the previous EISs on the Absaloka Mine (Montana Department of State Lands, 1979; Montana Department of State Lands, 1977; U.S. Department of the Interior, 1977) contain further information on the climate at Sarpy Creek.

AIR QUALITY

The quality of the air near the Westmoreland Mine is very good. Total suspended particulate (TSP) concentrations are well below federal and Montana standards. All monitoring sites, except one at the train-loading facility, measured TSP concentrations similar to those found at undisturbed areas in southeastern Montana.

Westmoreland operates an air quality monitoring network around the mine (table II-9). The federal and Montana ambient air quality standards for TSP (table II-10) have never been exceeded (figs. II-5 and II-6). The highest TSP concentrations would be expected to occur at site 2, located nearest the coal handling facilities. This is in fact the case. Still, even here, annual TSP concentrations average 50 ug/m^3 (micrograms per cubic meter) or less.

TABLE II-9

Location of Air Samplers

Site	Approximate Distance From Mine (Miles)*	Direction from Mine
2	--	--
4	2.8	SE
5	2	SE
6	1.5	E
7	2.5	NW
10	2	NE

*Distance from train-loading station

Rarely, probably during high winds, 24-hour TSP concentrations at site 2 have reached extremely high levels--over 700 ug/m^3. These levels exceed by far the federal and Montana 24-hour standard. But since site 2 is on the permit area, where the public does not have ready access, the ambient air quality standards do not apply. Moreover, even outside the permit, the 24-hour maximum TSP standard can be exceeded once per year (table II-10).

Farther from mining, annual average TSP concentrations closely match those found in other rural areas of Montana (Raisch et al., 1982). Very high 24-hour TSP concentrations have occurred only once at these monitoring sites during the past 5 years, again probably during high winds.

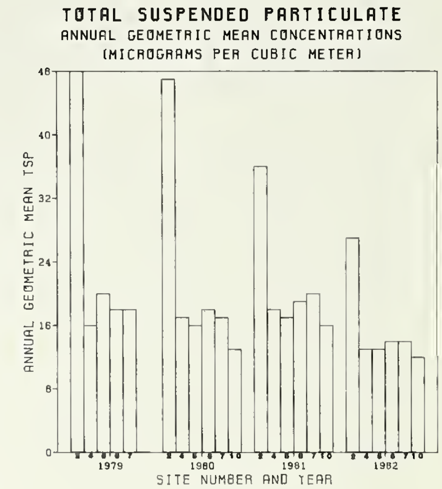
Dustfall (settled particulate), composed of large particles, is also monitored around the mine. The Montana standard (10gm/m^2 = 30-day average) was exceeded in 1981, but since the large dustfall particles settle to the ground very close to the source, they have little effect outside the mine.

Gaseous emissions at the mine, primarily from mine equipment, are not considered serious enough to require monitoring (Montana Department of State Lands, 1977, p. II-18).

TABLE II-10
Montana and National Air Quality Standards

Pollutant	Montana Standard	Federal Primary Standard	Federal Secondary Standard
Total Suspended Particulates	75 ug/m^3 annual arithmetic average 200 ug/m^3 24-hr average*	75 ug/m^3 annual geometric mean 260 ug/m^3 24-hr average*	60 ug/m^3 annual geometric mean 150 ug/m^3 24-hr average*
Sulfur Dioxide	0.02 ppm annual average 0.10 ppm 24-hr average* 0.50 ppm 1-hr average**	0.03 ppm annual average 0.14 ppm 24-hr average*	0.5 ppm 3-hr average*
Carbon Monoxide	9 ppm 8-hr average* 23 ppm hourly average*	9 ppm 8-hr average* 35 ppm 1-hr average*	9 ppm 8-hr average*
Nitrogen Dioxide	0.05 ppm annual average 0.30 ppm 1-hr average*	0.05 ppm annual average	0.05 ppm annual average
Photochemical Oxidants (ozone)	0.10 hourly average*	0.12 ppm 1-hr average*	0.12 ppm 1-hr average*
Lead	1.5 ug/m^3 90-day average	1.5 ug/m^3 calendar quarter average	None
Foliar Fluoride	35 ug/g grazing season 50 ug/g monthly average	None None	None None
Hydrogen Sulfide	0.05 ppm hourly average*	None	None
Settled Particulate (Dustfall)	10 gm/m^2 30-day average	None	NOne
Visibility	Particle scattering coefficient of 3 x 10^5 per meter annual average***	None	None

Note: ug/m^3=micrograms pollutant per cubic meter of sampled air; ppm=parts pollutant per million parts of sampled air
*Not to be exceeded more than once per year
**Not to be exceeded more than 18 times per year
***Applies to PSD Class I areas

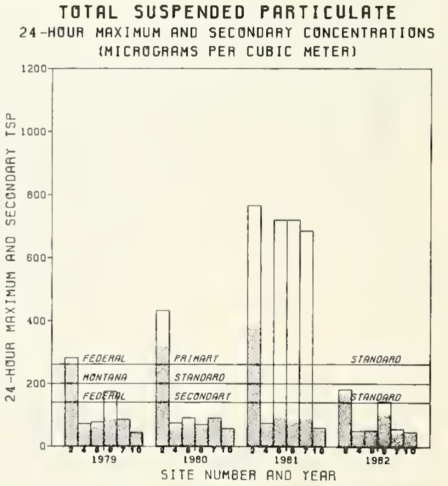


TOTAL SUSPENDED PARTICULATE
ANNUAL GEOMETRIC MEAN CONCENTRATIONS
(MICROGRAMS PER CUBIC METER)

SOURCE: WESTMORELAND RESOURCES, 1983, BOOK F

FIGURE II-5

Data show the air in the Absaloka Mine area to be of high quality. Annual geometric mean total suspended particulate concentrations have never exceeded federal standards. In micrograms per cubic meter, the federal primary standard is 75, the secondary standard, 60.



TOTAL SUSPENDED PARTICULATE
24-HOUR MAXIMUM AND SECONDARY CONCENTRATIONS
(MICROGRAMS PER CUBIC METER)

NOTE: SHADING SMOWS SECOND HIGHEST TSP RECORDED

SOURCE: WESTMORELAND RESOURCES, 1983, BOOK F

FIGURE II-6

Maximum 24-hour total suspended particulate concentrations have exceeded the levels specified in ambient air quality standards. However, the standards themselves have not been violated. Concentrations may exceed the standards' levels once per year without violation. In micrograms TSP per cubic meter, the federal primary standard is 260, the Montana standard 200, and the federal secondary 150.

ECONOMICS

Big Horn County

Industrial and Commercial Activity

Big Horn County grew and prospered during the last half of the nineteenth and first half of the twentieth century. Development focused on the basic agricultural economy that remains today.

Livestock production, both sheep and cattle, now dominates county agriculture. The Holly Sugar Company factory in Hardin, open until 1970, encouraged today's production of sugar beets (Historical Research Associates, Inc. [HRA], p. 107). Some grain, chiefly wheat and barley, is also grown in the county.

The two Indian reservations in Big Horn County, particularly the Crow Reservation, have helped shape the development of the county's economy (Mountain West Research-North, Inc., [MWR-N], 1983, p. 3-18; HRA, 1983, p. 108). Because of the reservations, federal government money has flowed to area businesses via employment and transfer payments to tribal members. Meanwhile, area ranchers have supported livestock operations by leasing grazing land on the Crow Reservation (MWR-N, 1983, pp. 3-18 and 3-19). In some respects, federal administration of much of the county's land may have encouraged the establishment of large corporate agricultural operations, such as the Campbell Farming Corporation and the sheep operation of Charles Bair (HRA, 1983, p. 108).

The opening of the Decker coal mine in 1972 and the Absaloka Mine in 1974 were the major industrial developments in the 1970s. The mine openings were the beginning of a new phase in the development of the county's economy.

Hardin is the principal trade center in the county. It is, however, a second-order center. That is, it provides some specialized goods and services, but has a limited market area. Consumers from the northern part of the county tend to bypass Hardin to shop in Billings. Southern Big Horn County residents tend to make their major purchases in Sheridan, Wyoming (MWR-N, 1983, p. 2-64).

Quantity and Distribution of Employment

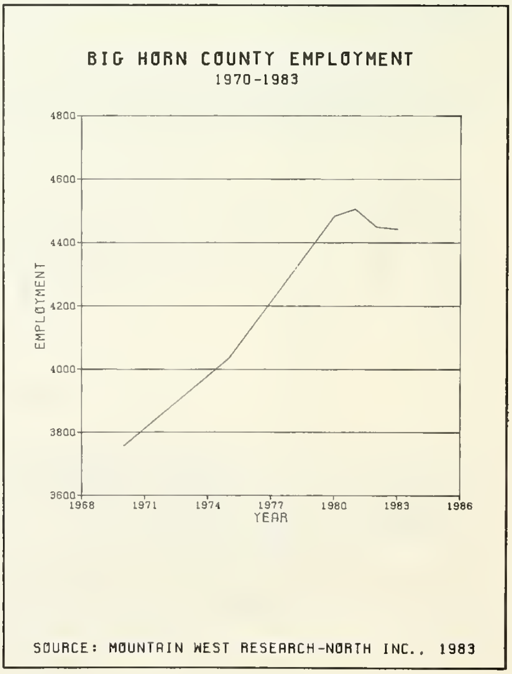
A computer model was used to generate much of the economic data for the EIS. (See Introduction.) The technique used by the model to project employment growth is called "economic (or export) base." The economic base approach assumes that an area's jobs can be divided into two sectors, basic and nonbasic. Basic jobs arise from work shaped by forces outside the area. This includes tourist-related business, government work, and business associated with selling an area's goods and services to the outside ("exporting"). Nonbasic jobs arise from work associated with goods and services sold inside an area. Nonbasic has many other names: induced, derivative, secondary, residentiary, and ancillary. The number of nonbasic jobs is believed to be determined by the number of basic jobs.

As in the rest of the U.S. between 1960 and 1980, the number of rural agricultural jobs in Big Horn County declined. Offsetting the decline was job growth in mining, construction, and services. Between 1970 and 1980, total employment increased by about 18 percent (fig. II-7), from 3,796 to 4,483 jobs (table II-11). Despite the decline, agriculture remained the largest basic employment sector in 1980, and it is likely to stay the largest in the future, because almost all Decker-area miners live in Wyoming.

Basic industry jobs in Big Horn County in 1980 stemmed from agriculture (41 percent), services (25 percent), government (18 percent), mining (11 percent) and other industries (5 percent) (MWR-N, 1983, p. 3-72). The high proportion of service and government employment demonstrates the importance of the Crow Indian Reservation to the county's economy.

Nonbasic employment in 1980 was dominated by jobs in the trade and services industries, which made up 51 percent of the sector. Other major employers were government (22 percent), construction (7 percent), finance, insurance, and real estate (5 percent), and transportation, communications, and utilities (5 percent) (MWR-N, 1983, p. 3-72).

Employment at the Absaloka Mine has gone up and down with changes in the amount of coal produced and construction of equipment and facilities (table



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE II-7

Growth in employment in Big Horn county during the 1970s was caused by a rise in mining, construction, and utilities jobs. The decline in the early 1980s stemmed from layoffs at the Absaloka Mine and cuts in federal spending on the reservations. (Note that the scale of the graph is exaggerated for emphasis.)

II-12). Layoffs at the Absaloka Mine in the early 1980s, together with the national recession and federal Indian program funding cutbacks, contributed to the decline in total employment in Big Horn County between 1980 and 1982 (fig. II-7).

TABLE II-11

Employment of Big Horn County Residents
By Sector, 1980

Industrial Sector	Total Employment Amount	Total Employment Percent	Basic Employment Amount	Basic Employment Percent	Nonbasic Employment Amount	Nonbasic Employment Percent
Agriculture	1,004	22.4	929	40.7	75	3.4
Mining	239	5.3	239	10.5	0	0
Construction	225	5.0	70	3.1	155	7.0
Manufacturing	49	1.1	0	0	49	2.2
Transportation, communications, and utilities	125	2.8	16	0.7	109	4.9
Trade	665	14.8	36	1.6	629	28.6
Finance, insurance, and real estate	131	2.9	13	0.6	118	5.4
Services	1,049	23.4	559	24.5	490	22.2
Government	996	22.2	418	18.3	578	26.2
Total	4,483	99.9	2,280	100.0	2,203	99.9

Source: MWR-N, 1983, p. 3-72

TABLE II-12

Production and Employment at the
Absaloka Mine, 1974-1983

Year	Production (million tons)	Employment Operations	Employment Construction	Employment Total
1974	1,457,673	110	176	276
1975	4,048,082	110	0	110
1976	4,083,894	110	0	110
1977	4,529,053	150	0	150
1978	4,554,201	150	0	150
1979	4,948,346	197	59	256
1980	4,905,882	185	0	186
1981	4,450,593	164	0	164
1982	4,159,219	132	0	132
1983	3,500,000	125	0	125

Sources: Westmoreland Resources, Inc., written commun., June 1, 1979, November 19, 1982; Montana Department of Revenue, various dates, unpublished quarterly report.

Community and Personal Income

Energy-related employment growth in Big Horn County between 1970 and 1980 markedly increased total and per capita personal income (MWR-N, 1983, p. 3-67). Total personal income (in constant dollars) increased by 60 percent, per capita income, by 45 percent (MWR-N, 1983, p. 3-74). Labor and proprietor's income, the fastest-growing contributor to the county's total personal income, more than doubled (MWR-N, 1983, p. 3-74), reflecting the relatively high salaries of mine workers. Much of the increase in the county was earned by residents of Sheridan County, Wyoming. This income went immediately to Wyoming, leaving Montana, so total personal and per capita income went up by a smaller percentage (MWR-N, 1983, p. 3-74).

The royalty payments paid to the Crow Tribe by Westmoreland Resources Inc. are nearly as important a source of personal income in the county as the jobs at the mine. Sixty percent of the total royalty payment (table II-13) is paid out to tribal members as dividend or per capita payments. In 1982, for example, the total mine payroll was about $4.4 million, while the royalty payment to the tribe was about $2.7 million. The part of the royalty not paid out as dividends has also boosted local incomes, since it was spent locally--to repurchase land once owned by the tribe or to finance other programs.

TABLE II-13

Royalties Paid to the Crow Tribe, 1974-1982

Year	Amount	Year	Amount
1974	$ 394,285	1979	$2,321,189
1975	1,495,143	1980	1,662,953
1976	1,614,139	1981	2,128,096
1978	1,790,805	1982	2,701,697

Source: Westmoreland Resources, written commun., June 1, 1979 and November 19, 1982

SOCIAL CONDITIONS

Big Horn County

Big Horn County, Montana, has developed, economically, socially, and politically, in a way similar to the surrounding area. The county was first inhabited by native people, principally the Crow and later the Northern Cheyenne Indians. Whites then explored and settled in the county, drawn first by an active fur trade and afterwards by an open-range cattle industry. From 1850 to 1950, the county grew and prospered (Historical Research Associates [HRA], 1983).

Big Horn County development has focused on one industry--agriculture--which has permeated political and social institutions. Sheep and cattle production have dominated, accompanied until 1970 by sugar beet production for the Holly Sugar Company factory in Hardin. Hardin, serving as a local trade center, has broadened the economic base, but many area residents have traded in Billings or Sheridan instead.

Big Horn County's land use history is unique. Unlike surrounding counties, the two Indian reservations have given control of almost two-thirds of the land in Big Horn County to the federal government. Moreover, the county was not organized until 1913, and therefore lacked coordination of land use until after that time (HRA, 1983).

Social Organization

Big Horn County today retains much of its agriculturally oriented economic, political, and social structure. Little industrial growth occurred in the first half of the twentieth century, when a strong agricultural identity developed. The county has only recently begun to experience a changing political and social environment from industrial expansion, principally coal development.

The expansion of the energy industry has given Big Horn County experience in dealing with energy-related growth. The experience has prepared residents, businesses, and governmental organizations to deal more effectively and pragmatically with future growth. The area's communities have established alliances and contacts with state and federal agencies and with other local governments that can provide information, money, and expertise. The experience with energy development has reduced the area's isolation and, in turn, integrated local concerns into regional, state, and national affairs. To some in the area, this has been viewed as advantageous, to others, as an intrusion of the outside world into local and personal relationships.

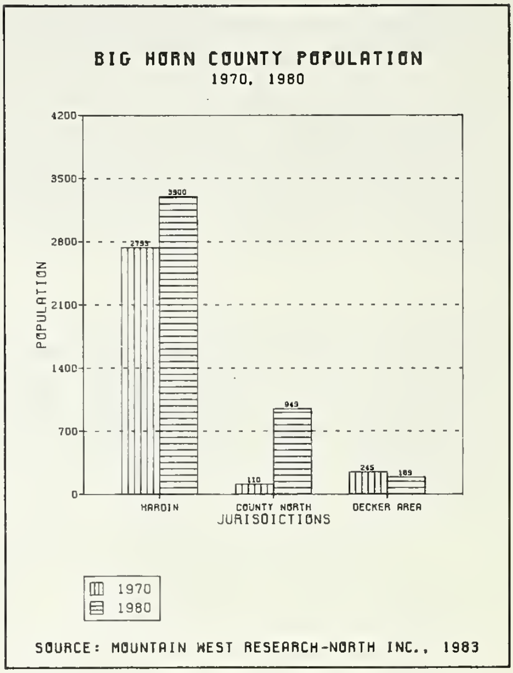
As the economy and population of the area have changed, the opportunities for political, economic, and social power (influence and status) have begun to adjust. As newcomers with professions or allegiance to outside organizations have become more numerous and important, and as the proportion of the population in the working ages has increased, the dominance of the elderly and of ranchers with "pioneer" heritage has been reduced. (For more information about social organization in Big Horn County, see MWR-N, 1983).

Big Horn County (Excluding the Reservations)

Population

Big Horn County is divided into three nonreservation subcounty areas: Big Horn County North, Hardin City, and Decker. Big Horn County North includes all of the county north of the reservations, except Hardin City. The Decker area includes all of southeastern Big Horn County outside the reservations.

Overall, the county's population increased 10.3 percent from 1970 to 1980, 3 percent slower than the state's population over the decade (fig. II-8 and app. D, table D-1). The three nonreservation units within the county underwent sharply different population changes. The northern part of the



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE II-8

Big Horn County's population as a whole grew only 10.3 percent during the 1970s. Parts of the county, however, such as the northern part, grew exceptionally fast.

county increased by a rapid 762.7 percent, the Decker area decreased by 22.9 percent, and the city of Hardin increased by 20.7 percent.

The median age increased in Big Horn County by over two years between 1970 and 1980 (table II-14). Even so, in both 1970 and 1980, the median age was more than three years less in Big Horn County than in Montana as a whole.

The percentage of nonwhites (mostly Crow and Northern Cheyenne Indian) in the population is much higher in Big Horn County than in the state as a whole (fig. II-9 and table II-14). Census figures show that the percentage of nonwhites increased from 40.2 in 1970 to 47.9 in 1980. (The Crow Reservation analysis assumed that the 1980 census undercounted Crow Indians living in Big Horn County by about 21 percent. If this is correct, Crow and Cheyenne Indians actually constitute over 50 percent of the county population, and the county's median age is probably lower.)

Housing

Between 1970 and 1980, the total number of housing units in Big Horn County grew 33.3 percent, while year-round units grew 29.8 percent (fig. II-10 app. D, table D-2). Of the year-round units, mobile homes grew fastest, 174.6 percent. In contrast, multifamily homes grew by 71.1 percent, and single family detached units grew by only 14.8 percent.

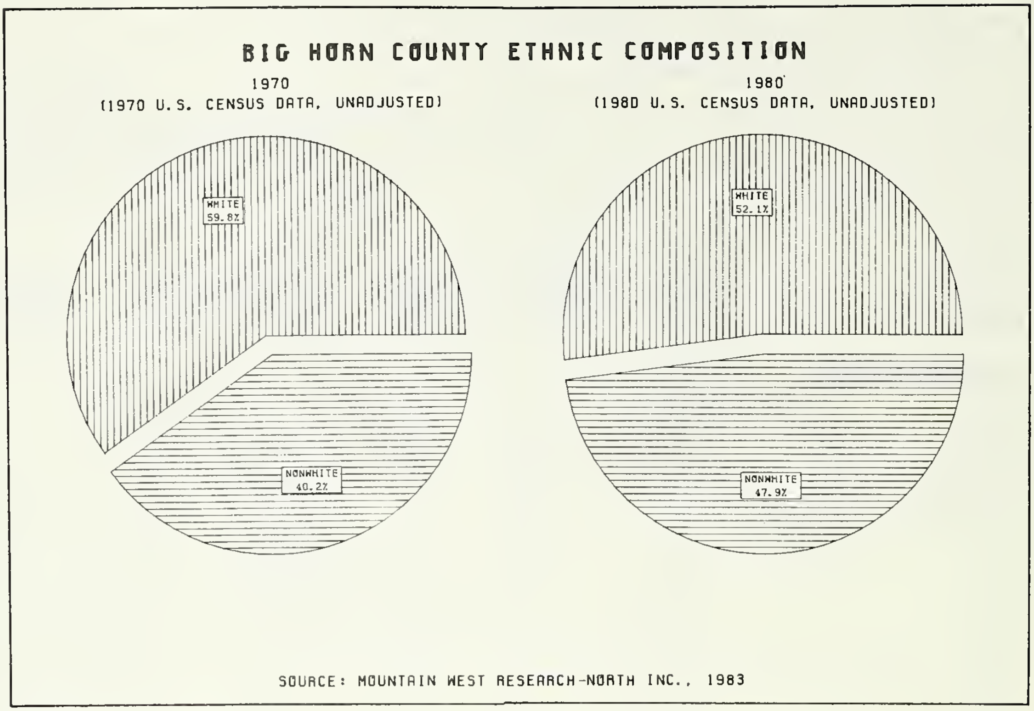
TABLE II-14

Distribution of Population by Age and Race
Big Horn County and Montana
1970, 1980

Population	1970			1980		
	Big Horn County		Montana	Big Horn County		Montana
Characteristics	Number	Percent	Percent	Number	Percent	Percent
Age Distribution						
Under 5	1,104	11.0	8.3	1,184	10.7	8.2
5-9	1,273	12.7	10.6	1,066	9.6	7.7
10-14	1,193	11.9	11.2	1,044	9.4	7.9
15-19	985	9.8	10.2	1,164	10.5	9.5
20-24	697	6.9	7.3	954	8.6	9.4
25-29	656	6.5	6.1	968	8.7	9.1
30-34	577	5.7	5.5	860	7.7	7.8
35-39	514	5.1	5.2	664	6.0	6.1
40-44	506	5.0	5.5	535	4.8	5.1
45-49	509	5.1	5.5	479	4.3	4.6
50-54	512	5.1	5.6	440	4.0	4.7
55-59	476	4.7	5.0	439	4.0	4.6
60-64	362	3.6	4.1	398	3.6	4.4
65+	693	6.9	9.9	901	8.1	10.7
Median Age	23.4		27.1	25.7		29.0
Ethnic Distribution						
White	6,018	59.8	95.7	5,781	52.1	94.1
Nonwhite	4,039	40.2	4.3	5,315	47.9	5.9
TOTAL POPULATION	10,057			11,096		

Source: U.S. Department of Commerce, Bureau of the Census, 1970 Census of the Population: Characteristics of the Population, Montana, Tables 19, 20, 34, 35, 49, 50; U.S. Department of Commerce, Bureau of the Census, 1980 Census of the Population: Characteristics of the Population, Montana, Tables 19, 20, 46.

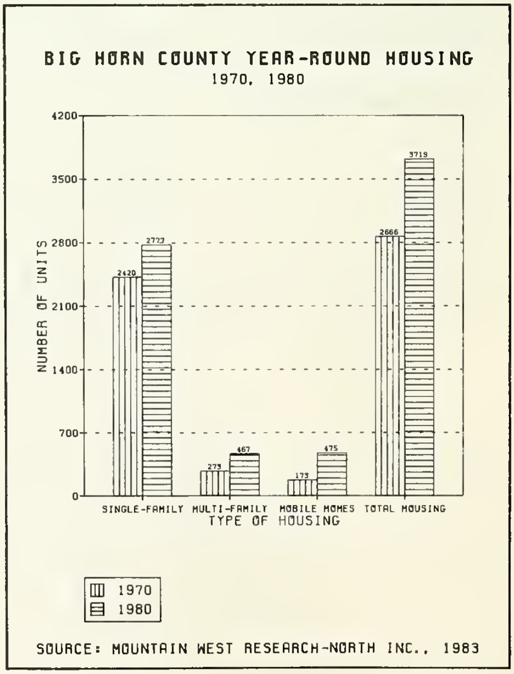
Note: These figures do not reflect the undercount of Crow Indians in the 1980 U.S. Census.



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE II-9 (above)

Whites dominated the population of Big Horn county in 1970 (left). Rapid population growth of the nonwhite (Indian) population has since brought the ratio of whites to nonwhites to nearly 50:50 (right).



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE II-10 (right)

The total number of housing units in Big Horn County grew by a third during the 1970s. The largest increase in the number of units was in single-family housing. The highest percentage increase was in mobile homes.

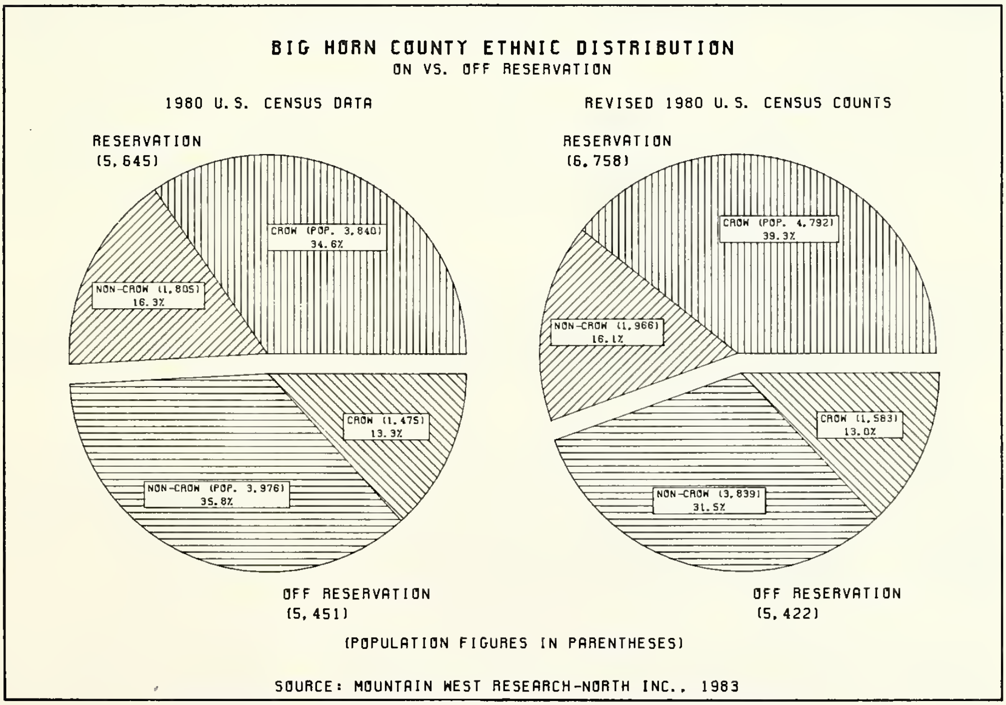
Crow Reservation

Population

The 1980 census counted 5,645 people on the reservation. Because information from the Crow Tribe indicates that the census may have undercounted Crow Indians by as much as 21 percent (app. D, table D-3), the actual population may be much higher (fig. II-11).

Housing

Housing for Crow Indians on the reservation is insufficient to meet current demand (MWR-N, 1983, 1983, p. 4-121). This is partly because of the U.S. Department of Housing and Urban Development (HUD) moratorium placed on house financing in the late 1970s and early 1980s. The moratorium has recently been lifted, and 115 new units are scheduled for construction.



BIG HORN COUNTY ETHNIC DISTRIBUTION
ON VS. OFF RESERVATION

1980 U.S. CENSUS DATA

REVISED 1980 U.S. CENSUS COUNTS

(POPULATION FIGURES IN PARENTHESES)

SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE II-11

U.S. Census figures (left) may not accurately reflect the size of the Crow Indian population in Big Horn County. Adjusted for a possible undercount (right), the 1980 census figures show a much greater proportion of Indians.

Northern Cheyenne Reservation

Population

In 1980, the population on the Northern Cheyenne Indian Reservation was 3,255, about 822 (25 percent) of which was in Big Horn County. The Northern Cheyenne population has a younger median age than the surrounding non-Indian population: about 50 percent of the Indians are sixteen years of age or younger. (For more detailed population characteristics, see Northern Cheyenne Tribe Planning Office, 1981.)

Housing

In 1980 there were 288 housing units on the Big Horn County portion of the Northern Cheyenne Reservation. Of the total, 217 were Indian and 71 were non-Indian units (MWR-N, 1983, p. 3-205).

SOCIAL AND COMMUNITY SERVICES

Big Horn County

The county provides the following services:

- general government
- engineering and planning
- law enforcement
- fire protection
- hospital care
- library
- human and health services
- parks and recreation
- solid waste disposal
- education

Most of these services are administered from Hardin, but equipment and personnel are stationed in various locations. Some of these and additional services (i.e., water and sewage) are also provided by the city of Hardin. A detailed description of each service is contained in a 1983 report by Mountain West Research-North, Inc. (MWR-N, 1983).

General government staffs and facilities are now adequate for both Hardin City government and Big Horn County government. The county has enough engineering and planning space, staff, vehicles, and equipment, but not enough county shop space, for current needs. A new shop is planned that will be adequate for today's needs. Hardin's engineering and public works department now has sufficient personnel and space.

The sheriff's department provides law enforcement for the county and city of Hardin. The number of staff (18 to 20) and vehicles (9) has not changed for the past few years and appears adequate. A recent addition to the courthouse makes the facility adequate for current needs.

The Big Horn County fire department, staffed entirely by volunteers, serves the unincorporated parts of the county. Buildings and equipment are adequate for current needs. Hardin's fire protection is provided by a 20-member volunteer department. Present needs do not require a paid staff or additional equipment.

The Big Horn County Hospital is a self-supporting nonprofit government agency. Fees and charges cover operating and maintenance costs. Capital equipment is purchased by the county. The hospital has 16 acute and 34 long-term care beds. The acute care beds now average 56 percent occupancy and long-term beds nearly 100 percent occupancy. By either local or national standards, bed space is adequate.

The hospital also provides nursing-home beds. The 1983 expansion program, the new 36-bed nursing home, and 20-unit retirement home should provide adequate hospital services for current needs.

The Big Horn County library in Hardin serves the entire county. Facilities are considered adequate, although the librarian feels expansion could be necessary if the population increases significantly (MWR-N, 1983, p. 3-87).

Ambulance and public health services are provided for the entire county from Hardin. The privately owned ambulance service has sufficient personnel and equipment to adequately serve current needs. The number of public health personnel has remained constant in recent years. The large variety of services offered is difficult to evaluate, but the services appear to be adequate.

Big Horn County oversees the county fair board and the county park board. The fairgrounds have recently been expanded for social events. The county park board has coordinated construction at the fairgrounds of softball fields, which were built using county funds and volunteer labor. The resulting increase in recreation facilities adequately serves the current population.

Hardin now contains 5 acres of developed and 2.25 acres of undeveloped park land. Two to three additional acres may be needed soon; the town already owns the additional acreage.

Big Horn County takes part in a tricounty solid waste system established in 1978. Collection is adequately supplied by private contractors. The landfill site, owned by Hardin but operated by the county, covers about 40 acres and is adequate for current needs.

Hardin is responsible for garbage collection in town, using two trucks, each with a crew of three. No new trucks or equipment are necessary to meet current demands.

Hardin's water system has been gradually renovated over the past 20 years. The treatment facility has a capacity of 4 million gallons per day and is adequate for a population of 27,000. Water storage capacity is sufficient for a population of 6,500. Both treatment and storage capacity are adequate.

Hardin's sewer system is new and consists of oxidation ditches and an activated sludge plant. Local sources indicate that the system's 1-million-gallon capacity is adequate for a population of 6,000.

Education

Public education in Big Horn County is provided by three high schools and ten elementary schools. The county is divided into seven elementary school districts and three high school districts (fig. II-12). During the 1982-1983 school year, the county's public schools enrolled approximately 670 high school students and 1,600 elementary school students.

All thirteen public schools have enough teachers to serve current enrollments. Eleven schools have surplus capacity, one (Lodge Grass High School) has adequate capacity, and one (Lodge Grass Elementary School) has inadequate capacity.

Two private schools, St. Charles Mission School in Pryor and Pretty Eagle School in St. Xavier, also serve Big Horn County. Little Big Horn College is located in the county as well. The two private schools employ 17 teachers and the college has 2 full-time and 16 part-time instructors.

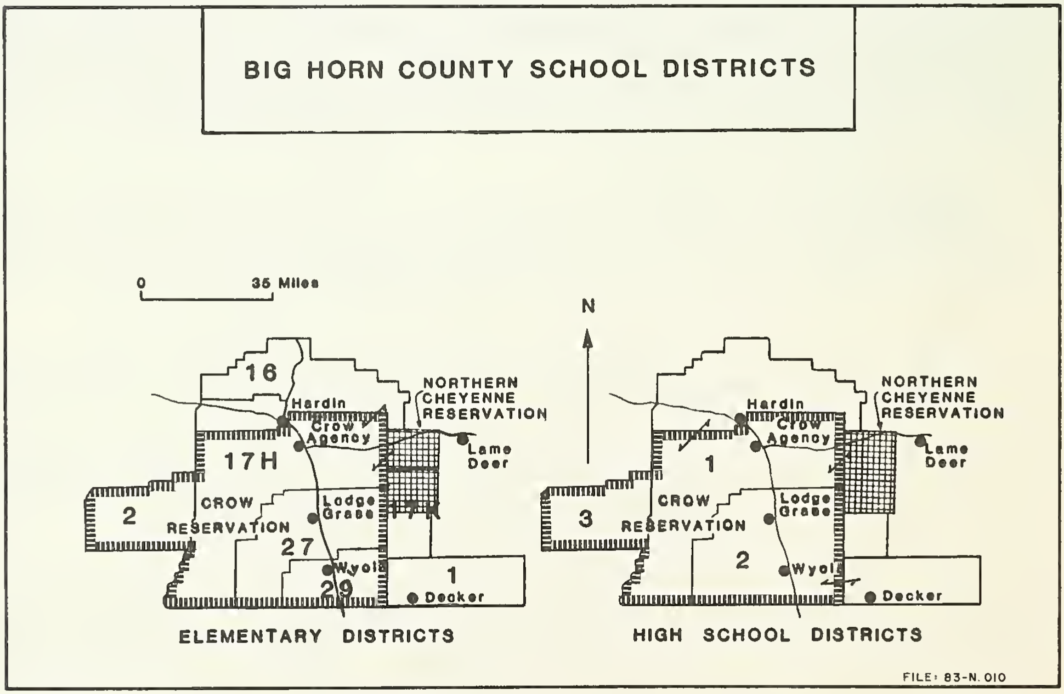


FIGURE II-12

Big Horn County has seven elementary and three high school districts. Elementary district 17H and high school district 1 are the most affected by the Absaloka Mine.

Crow Reservation

In many cases, the financing, administration, and operation of public facilities and services on the Crow Indian Reservation involve many government units. The Crow Indian Tribal Government (CITG), Bureau of Indian Affairs (BIA), Indian Health Service (IHS), other federal and state agencies, and local public and private organizations provide services to reservation residents. The public facilities and services (described in MWR-N, 1983) in operation on the Crow Indian Reservation include the following:

- general government
- police
- fire protection
- hospital and health services
- social services
- mental health services
- community health services
- recreation facilities

General government staff and facilities for Crow Indian tribal government are now adequate. The police staff of 15 sworn officers is considered barely adequate. The seven patrol vehicles are adequate for the number of officers. The public safety building, providing office, dispatch, and detention facilities, has surplus capacity.

The six part-time Bureau of Indian Affairs Forestry Department fire personnel are not adequate to serve the reservation's range and forest fire needs. Additional fire space and equipment are also needed. Structural fire protection is provided by the county.

The number of physicians serving the reservation, now totaling five, is not sufficient. The number of dentists (three) is adequate. The number of existing hospital beds (34) is also adequate. Ambulance service for emergencies is contracted through a private Hardin service covering the entire county. The distance from Hardin to some points on the reservation can cause emergency service to be inadequate.

The reservation is served by one medical social worker, one mental health specialist, and four community health nurses. More medical social workers, mental health workers, and space are needed for the reservation population. More community health nurses are also needed.

Northern Cheyenne Reservation

Social and community services provided on the Northern Cheyenne Reservation, described in the Northern Cheyenne Planning Office's report (August 1981), include--

- tribal government
- law enforcement
- health services
- water supply

- waste disposal
- fire protection

The Westmoreland Mine has had little effect on the Northern Cheyenne Reservation. (For a detailed description of six social and community services see the Final Comprehensive Environmental Impact Study, Western Energy Company's Rosebud Mine [July, 1983]). In general, tribal government and health services have enough personnel and operating space. Water supplies and waste disposal in some communities are not adequate and some systems need expansion or modification. Fire protection for forests and prairie is adequate, but building and auto fire protection is not. More personnel are needed in the Northern Cheyenne Police Department.

FISCAL CONDITIONS

Big Horn County Government

In fiscal year 1982 (July 1981-June 1982), about 84 percent of Big Horn County's general fund revenues came from local sources. The remaining 16 percent came from intergovernmental transfers (fig. II-13). Property taxes were the largest local source, providing about $1.5 million (59 percent) of total revenues. Other local sources included licenses and service charges, fines and forfeitures, and miscellaneous revenues (Mountain West Research-North [MWR-N], 1983, p. 3-89).

Property taxes are generated by a mill levy on the county's property tax base (taxable value). The coal industry provided more than 80 percent of the county's tax base in fiscal year 1982 (Montana Department of Revenue, 1983, p. 9). The largest source of taxable value was the gross proceeds value of coal production, which is defined as 45 percent of the contract sales price per ton times the taxable tonnage sold.

The Absaloka Mine provided about 13 percent of the county's tax base in fiscal year 1982. The gross proceeds value of the coal produced at the mine during calendar year 1981 made up 11 of the 13 percent (Montana Department of Revenue, 1983, p. 9, and John Hodnik, Mountain West Research-North, written commun. Sept. 19, 1983).

The county's tax base rises and falls with the rate of coal production and coal prices. Between fiscal year 1981 and 1982, for example, the gross proceeds value rose from about $71 million to $91 million, accounting for most of the change in total county taxable value from about $108 million to $124 million (Montana Department of Revenue, 1983, p. 9). The increase came mostly from expansion at the Spring Creek Mine. Because production fell sharply in 1982, fiscal year 1983 gross proceeds taxable value will fall sharply, to about $81 million (Montana Department of Revenue, quarterly coal production report, unpublished).

In recent years, county spending has risen faster than inflation. Both total and per capita expenditures have grown an average 20 percent per year

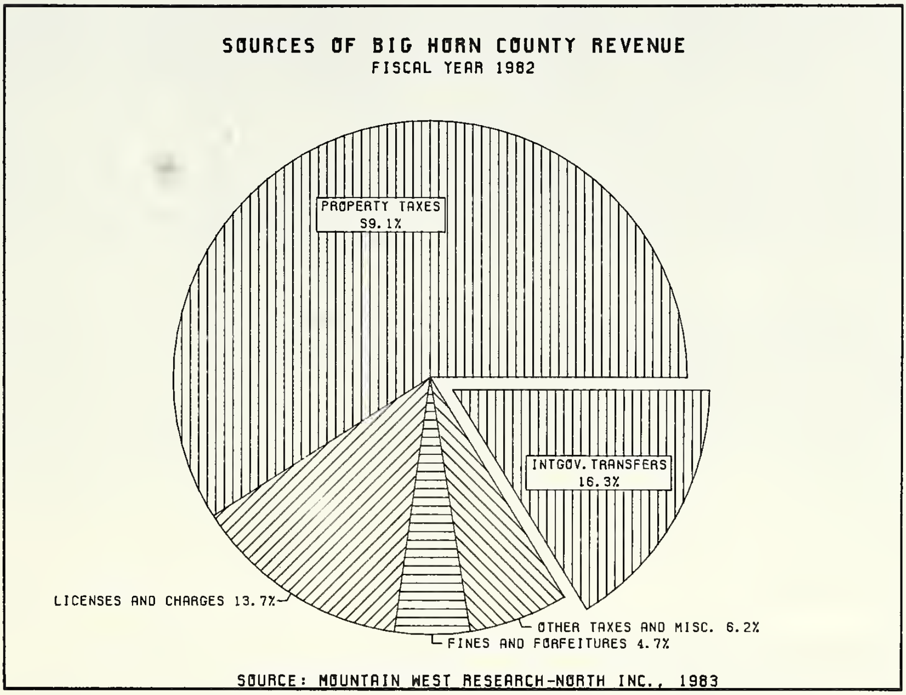


FIGURE II-13

Most of Big Horn County's revenue comes from within the county. But a significant amount, intergovernmental transfers, comes from outside, "nonlocal," sources.

(MWR-N, 1983, p. 3-88). The county is now taxing about 34 mills, including about 15 for the general fund, 12 for the road fund, 3 each for the poor fund and bond retirement, and 1 for bridges (MWR-N, 1983, p. 3-90). Since the general fund is limited to 25 mills, the county has about 10 more mills available to fund future cost increases.

City of Hardin

The city of Hardin has no particular problems managing its finances. Because the city relies mainly on property taxes for revenue, however, it could have difficulty paying for any sudden jump in expenses caused by growth. The difficulty would stem from the inherent lag in the property tax base: Revenues, based on taxable value, would go up only after expenses. An additional problem for Hardin could come from a mismatch between the location of growth and the location of taxable value. That is, the coal development that could fuel the city's growth would occur outside the city's taxing jurisdiction; the growth would raise expenses but not directly add to the tax base (MWR-N, 1983, p. 3-144).

In fiscal year 1982, about 75 percent of the city's general fund revenues came from local sources. The remaining 25 percent came from nonlocal sources such as intergovernmental transfers. Property taxes were the largest local source, providing about $204,000 (46 percent) of total revenues. Other local sources included licenses and permits, fees and charges, other taxes, and miscellaneous revenues (MWR-N, 1983, p. 3-141).

The city operates water, sewer, and garbage utilities, each completely supported by user fees and charges. System revenues have been more than sufficient to cover costs, including debt repayment (MWR-N, 1983, p. 3-144).

The city's tax base (adjusted for inflation) has declined slightly since 1980. The decline is probably due to the court-mandated 12 percent reduction in the taxable value of commercial establishments. Despite the decline, the total municipal property tax levy has dropped 7 mills since 1980. As a result, total revenues (and budget) have also declined. Hardin now levies about 61 mills of the maximum allowable 65 mills for general purposes. It levies 22 more mills for special purposes, such as capital improvements, firemen's pension funds, city-county planning, parks and playgrounds maintenance, and insurance.

Crow Reservation

In fiscal year 1983, about 54 percent of the tribe's revenues came from local sources. The remaining 46 percent came from nonlocal sources, chiefly federal government grants and federal contracts to provide services to tribal members. Royalties paid by Westmoreland Resources were the largest local source, providing about $2.4 million (40 percent) of total revenues. Other local sources included oil and gas leases and royalties, grazing and land leases and interest (MWR-N, 1983, p. 3-171).

Sixty percent of the coal royalties must be distributed to tribal members and 20 percent must go to land purchases. As a result, most revenue for government services and programs comes from sources other than royalties, principally federal contracts and grants. In recent years, the availability of federal revenue has dropped sharply: The fiscal year 1983 figure of about $2.4 million is only a fraction of the $10 million taken in during most previous years (MWR-N, 1983, p. 3-170).

The Crow Tribe does not tax its members, and thus has no means of internally funding major capital improvements. Most of the major capital improvements made on the reservation come from direct contracts or grants from the federal government (MWR-N, 1983, p. 3-170).

School Districts

Most funding for operating the school districts in Big Horn County comes from some combination of four sources: countywide property taxes, district property taxes, state equalization money, and federal impact payments. The minimum funding amount per student is set by the Montana Legislature. This amount depends on the total number of students in a school district and the district's school level, elementary or high school. Districts with fewer students have a higher per-student funding, and high school districts get more per student than elementary districts.

Eighty percent of the minimum school funding comes from a mandatory mill levy on all the taxable property in the county. If resulting revenues do not cover 80 percent of the minimum, the state equalization fund pays a supplement. If the revenues cover more than 80 percent, the county pays the excess to the state equalization fund.

Before coal development began, Big Horn County received state equalization funds. At that time, the county had a low per-student taxable value because much of the land and property in the county is on an Indian reservation and not generally subject to property taxes. (See fig. II-12.) Since then, the enormous taxable value of the Decker area mines and the Absaloka Mine have reversed the flow of funds. About 32 percent of the money raised in the county in 1982 was paid into the equalization fund.

Until 1983-84, the mandatory Big Horn County mill levy stood at 40 mills, 25 for elementary districts and 15 for high school districts. Beginning in 1983-84, the mandatory levy is 45 mills, 28 for elementary districts and 17 for high schools.

The 20 percent of minimum funding not provided through the mandatory levy is provided by an additional tax on property in the individual district. This property tax, called the permissive levy, can only be enough to complete minimum funding, up to as much as 9 mills for elementary districts and 6 mills for high schools. If the revenue raised through the permissive levy does not complete the minimum, the state equalization fund makes up the difference.

To raise the budget above the amount provided by the equalization minimum, and to fund the other functions of the schools, the district can tap a variety of sources. The main local source is an increase in the property tax, which must be approved by the voters. Other sources of income are a variety of combinations of state, county, district and federal sources. Transportation, special education, capital improvements, and other functions are the primary items funded by these extra monies.

School districts that are directly affected by federal projects or that contain federal employees qualify for federal impact assistance. The assistance, which comes in the form of "PL 874" money, is provided for by a program established by Public Law (PL) 874. Since the Crow and Northern Cheyenne Reservations are considered federal impact areas, school districts with Indian students may apply for PL 874 money. This money goes directly to the school district. It does not necessarily affect the level of district and state foundation funding.

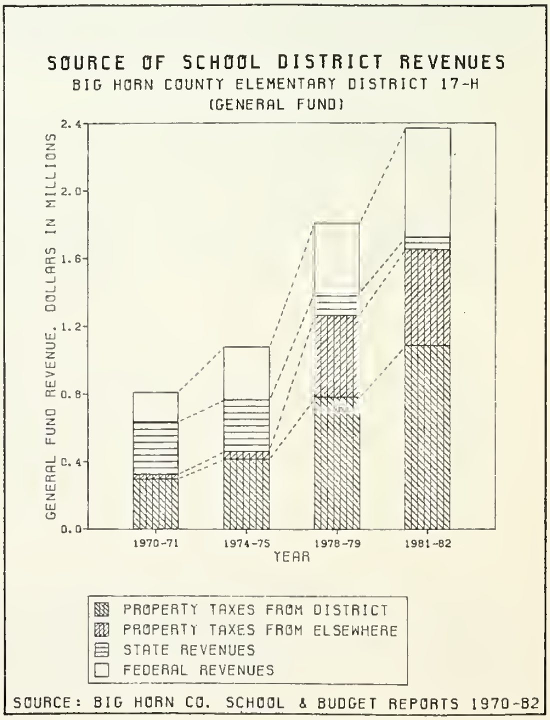
The Absaloka Mine is located in elementary school district 17-H and high school district 1. (See fig. II-12.) Before development at the Absaloka Mine (1970-71), most revenues for schools came from outside the county: 38 percent came from the state and 22 percent from the federal government. Only 37 percent of the elementary district's general fund revenue was raised in the districts, and 4 percent came from property taxes elsewhere in the county (fig. II-14).

The addition of the Absaloka Mine to the tax rolls and changes in state law that implemented the Gross Proceeds tax redistributed the tax burden. The responsibility for school funding shifted into the district and rest of the county. (See 1974-75 in fig. II-14.) By the 1981-82 school year, the state and "elsewhere in county" roles were reversed, and the local district was responsible for a much higher proportion of school funding.

In school year 1981-82, general fund revenues for elementary district 17-H totalled $2,369,498. The bulk, 46 percent ($1,089,364), came from property taxes paid in the district through the mandatory, permissive, and voted levy. Twenty-four percent ($567,402) came from property taxes paid elsewhere in the county through the mandatory levy. Twenty-seven percent ($641,268) came from the PL 874 program, and the remaining 3 percent ($71,464) came from the state through the school equalization fund. The high school district had a similar revenue pattern (fig. II-15).

State Revenues

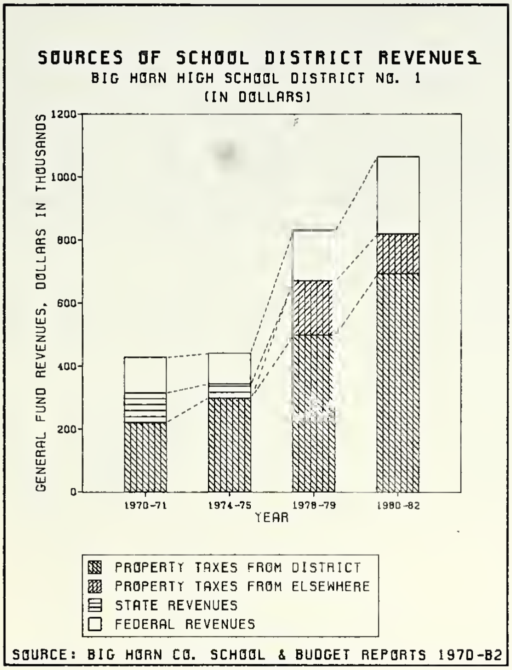
Almost all revenue received by the state of Montana from coal development is based on the value of the coal sold. The state levies four main taxes: Coal



SOURCE: BIG HORN CO. SCHOOL & BUDGET REPORTS 1970-82

FIGURE II-14

The sources of elementary district 17-H's revenues show a shift in funding responsibility: The state's support has dropped to near zero; funding from within the district itself and from elsewhere in the county has increased accordingly. The school district is, in a sense, fiscally self-sufficient, owing to the high taxable value of both the Absaloka Mine and other mines elsewhere in the county.



SOURCE: BIG HORN CO. SCHOOL & BUDGET REPORTS 1970-82

FIGURE II-15

Revenue sources in high school district 1 closely resemble those of elementary district 17-H. Note in the 1978-79 fiscal year the disappearance of state revenues and sudden appearance of revenues from elsewhere in the county.

Severance, Resource Indemnity Trust, a six-mill property tax, and the Corporate License Tax (an income tax). The state school trust also receives royalties from the state-owned coal that is mined at the Absaloka Mine.

The severance tax, 30 percent of the contract sales price, generates the most revenue for the state (table II-15). The contract sales price equals the gross sales price less production taxes and an adjustment for royalties paid.

TABLE II-15

Summary of Tax and Royalty Payments Made By Westmoreland Resources, Inc., 1980-82

	State of Montana			Crow Tribe	Federal Government	
Year	Severance Tax	Royalties	Property Taxes	Royalties	Black Lung	Abandoned Mine
1980	$8,612,038	$341,598	$1,743,214	$1,662,953	$829,985	$1,716,841
1981	9,030,946	208,276	1,768,148	2,128,096	884,855	1,557,603
1982	9,118,901	40,572	1,706,447	2,701,697	1,788,464	1,455,727

Sources: David W. Simpson, Westmoreland Resources Inc., written commun., Nov. 19, 1982, oral commun., Oct. 4, 1983; Montana Department of Revenue, unpublished quarterly report; John Hodnik, Mountain West Research-North, written commun., Sept. 19, 1983.

In the fiscal year ending June 30, 1981, the Coal Severance Tax produced about 16.5 percent of all the state's tax revenue and about 4.6 percent of total receipts (Montana Department of Administration, 1981, p. 23). The revenues raised through the tax are used in a variety of ways. These uses have changed in the past, are scheduled to be changed in the future (table II-16), and no doubt additional changes will occur from time to time. The principle function of the tax is to convert a lump sum yearly payment into continuous income. This is accomplished by the distribution of the tax into a series of special purpose trust funds which in turn are managed by the state to produce investment income. The tax revenue is an important support of other interests of the state in areas of general and special government services.

Royalties on state-owned coal mined at the Absaloka Mine are the next largest revenue producer. Royalties are paid at the rate of 17.5 cents per ton.

The remaining three taxes produce far less income for the state. The Resource Indemnity Trust tax is 0.5 percent of the contract sales price. The six-mill property tax is based on the gross proceeds and other taxable value at the mine. It goes to support the university system. The Corporate License Tax is levied at the rate of 6.75 percent on the net income of corporations.

Federal Revenues

The Federal government receives revenue from the corporate income tax, the Black Lung Excise tax, and the abandoned mines reclamation fee. The corporate income tax varies with the company's year-to-year profits. The Black Lung Excise tax is calculated as 4 percent of the gross sales or f.o.b. (freight on board) price of the coal. The abandoned mines reclamation fee is $0.35 per ton of coal.

LAND USE PATTERNS

Land use patterns in Big Horn County changed little during the coal development period of the 1970s. Agriculture, although declining in area covered from 87 to 86 percent, remained the dominant land use (Mountain West Research-North, Inc. [MWR-N], 1983, p. 3-47).

The changes in land use were concentrated in towns and at minesites (MWR-N, 1983, p. 3-47). Growth outside incorporated areas has generally occurred in scattered parcels (MWR-N, 1983, p. 3-48). One new town--Spring Creek--was planned: It received the necessary permits, was platted, had streets cut to grade, and sewer and water systems and trunk lines installed (MWR-N, 1983, p.3-51). To date, the town has not attracted any permanent residents.

The county seat, Hardin, has expanded its corporate boundaries through annexation. Growth in or near the city has been relatively orderly, because zoning and subdivision regulations are enforced (MWR-N, 1983, p. 3-47,3-48).

TABLE II-16

Disposition of the Coal Severance Tax
(data are in percent of total collection)

	July 1, 1977-June 30, 1979	July 1, 1979-Dec. 31, 1979	Jan. 1, 1980-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987 June 30, 1993
Constitutional Trust Fund	25.0	25.0	50.0	50.0	50.0
General Fund	30.0	28.875	19.0	16.72	14.44
Local Impact and Education Trust Fund	19.875	28.125	18.75	16.5	14.25
Coal Area Highway Improvement	9.75	0	0	0	-0-
Highway Reconstruction Trust Fund	0	0	0	6.0	12.0
State Public School Equalization	7.5	7.5	5.0	4.4	3.8
Alternative Energy Research Development and Demonstration	1.875	1.875	2.5	2.2	1.9
Renewable Resource Development Bond Account (Sinking Fund)	1.875	1.875	1.25	1.1	0.95
Parks and Art Trust Fund	1.875	3.75	2.5	2.2	1.90
Producing County	1.5	1.5	0	0	0
County Planning (Statewide)	0.75	0.75	0.5	0.44	0.38
State Library Commission	0	0.75	0.5	0.44	0.38

The mines in Big Horn County today--Absaloka, Decker and Spring Creek--have approval to mine 16,559 acres. The mine companies have submitted applications for permits on another 6,283 acres (Department of State Lands, April 1, 1983). The combined 22,842 acres have been, or would be, temporarily converted from agriculture to coal mining activities. This acreage makes up about 0.7 percent of the county's total acreage (MWR-N, 1983, p. 3-49).

The application area is located on the 15,386-acre leasehold made up of the Crow Tract III and a state section (number 36) (fig. II-16). The land use pattern of the application area is generally similar to that of the entire leasehold (fig. II-16 and table II-17). The major difference is that the application area has a greater proportion of cropland and ponderosa pine and a lesser proportion of rangeland and other uses.

The average condition of the grazing land (rangeland plus ponderosa pine) in the present permitted area and the application area is fair. The area has a recommended stocking rate of 0.23 animal unit months (AUMs) per acre, yielding about 484 AUMs of grazing capacity (Westmoreland Resources, 1983, bk. E, ex. E-6). The cropland has some additional forage potential in aftermath grazing. The application area is in similar condition and has a recommended stocking rate of about 0.26 AUMs per acre, yielding 85 AUMs of total grazing capacity. Aftermath grazing would add an additional 25 AUMs.

The cropland in the application area has a predicted average yield of 15 bushels per acre of wheat or 22 bushels per acre of barley, or 1 ton per acre of alfalfa hay (Westmoreland Resources, 1983, bk. E, ex. E-7). Average annual production for the application area would be about 1,000 bushels of wheat (or 1,500 bushels of barley) and 88 tons of alfalfa hay.

TRANSPORTATION NETWORKS AND TRAFFIC FLOWS

Roads and Highways

Big Horn County has 81 miles of interstate (I-90), 79 miles of primary, 160 miles of secondary, 900 miles of county and 375 miles of Indian and national roads (Mountain West Research-North, 1983, p. 3-29). (See fig. II-17.) The Absaloka Mine is reached via Federal Aid Secondary (FAS) 384 and County Road 55 (fig IN-1). FAS 384 functions well for the terrain and vehicles now using the route. FAS 384 was completely reconstructed in 1977 and 1978. The part between Hardin and the mine had an average daily traffic (ADT) of between 400 and 440 in 1981 (Montana Department of Highways, 1981, p. 198).

Rail Network

The Absaloka Mine is connected to the Burlington Northern mainline by a spur. Currently, an average of about 16 unit coal trains per week (8 each way) travel the spur. Train traffic heads east after reaching the Burlington Northern mainline. The train traffic contributes to the increasing congestion

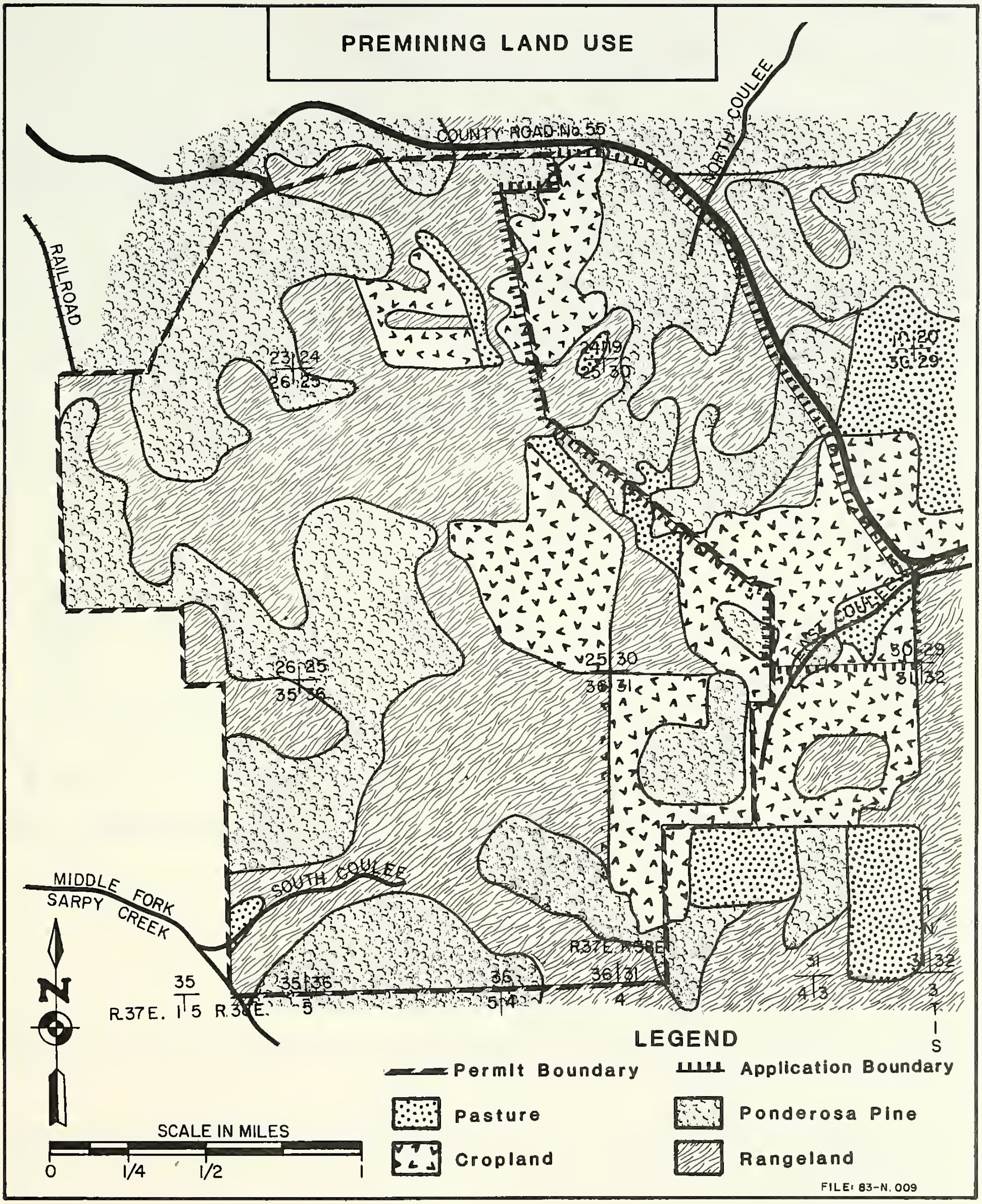


FIGURE II-16

Land uses in the Absaloka Mine area are divided between grazing land (pasture, ponderosa pine, and rangeland) and cropland. The bulk of the area is used for grazing.

TABLE II-17

Land Use Pattern in Tract III and State Section 36
(in acres)

	Premining Total[1]	Existing Total[2]	Postmining Total[3]
Undisturbed			
Rangeland[4]	8,800	8,181	6,020
Cropland	1,662	1,463	547
Ponderosa Pine	3,385	2,810	1,949
Other	1,539	1,539	1,515
Subtotal	15,386	13,993	10,031
Disturbed			
Active Mining	0	650	0
Facilities & Construction	0	265	0
Associated Disturbance	0	101	0
Other	0	101	0
Subtotal	0	1,117	0
Reclaimed[5]			
Rangeland	0	257	5,066
Cropland	0	0	0
Ponderosa Pine	0	14	261
Other	0	5	28
Subtotal	0	276	5,355
TOTAL	15,386	15,386	15,386

Sources: Michelle D. Mitchell, Westmoreland Resources Inc., written commun., September 6, 1983; oral commun., September 13, 1983; January 24, 1984.

[1] January 1972.

[2] January 1983.

[3] ending in 2016.

[4] Includes some open stands of ponderosa pine.

[5] Areas outside those currently permitted or applied for were assumed to be reclaimed to rangeland; some Ponderosa pine and cropland would probably be replaced.

at railroad crossings that are not separated by over or underpasses in towns to the east of the junction.

Ranchers along the spur line have reported some problems, such as overall inconvenience, trespass and litter during construction, minor erosion around culverts, and some accessibility restrictions. One grass fire was believed to have been caused by a train (Alan Newell, Historical Research Associates, written commun., Dec. 16, 1982).

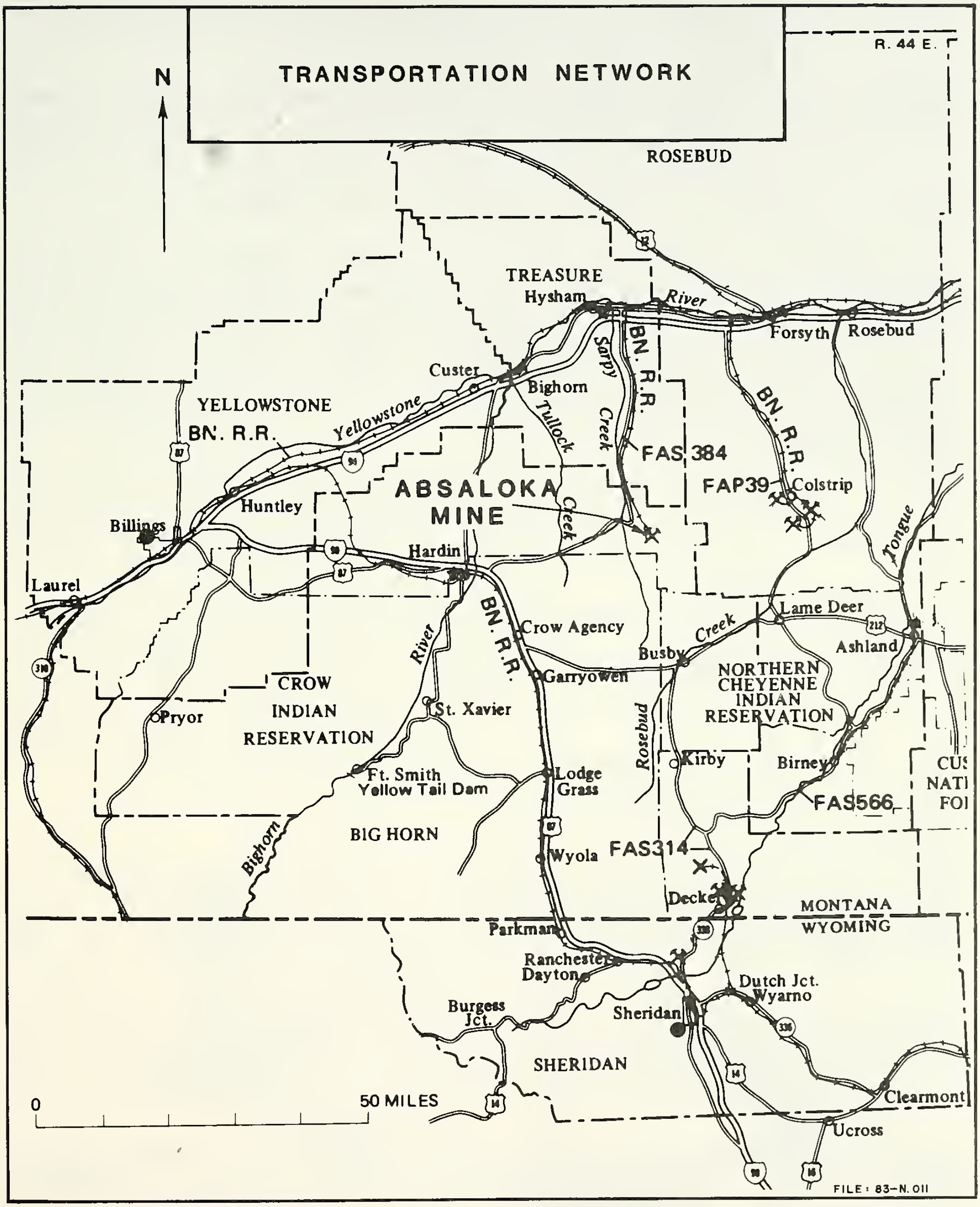


FIGURE II-17

The Absaloka Mine is served by FAS 384. Westmoreland ships all coal on the Sarpy Spur, the railroad line that extends north from the mine to the Burlington Northern mainline along the Yellowstone River.

OUTDOOR RECREATION

Bighorn Canyon National Recreation Area, Bighorn National Forest, and Custer National Forest provide the bulk of land for outdoor recreation in the region surrounding the Westmoreland Mine (fig. II-18). Added to this in Big Horn County are four fishing access sites, the Tongue River Reservoir, and several historic preserves. (See app. D, table D-4, for a complete list.)

Taken as a whole, the capacity of regional outdoor recreation areas appears adequate to accommodate current recreational activities (Mountain West Research-North, Inc., [MWR-N], 1983, p. 4-43). Montana Department of Fish, Wildlife and Parks estimates of statewide recreation rates and trends indicate that the supply of recreation areas is adequate. Bighorn National Forest supply and demand data lead to similar conclusions. On a regional level, present demand does not cause overcrowding or overuse of outdoor recreational areas, based on the capacity levels and management objectives of state and federal agencies.

In local areas, in contrast, some shortages may arise. Unequal distribution of people (over the days of the week, months of the year, sites, and activities) occasionally causes overcrowding. Some camping and picnic areas

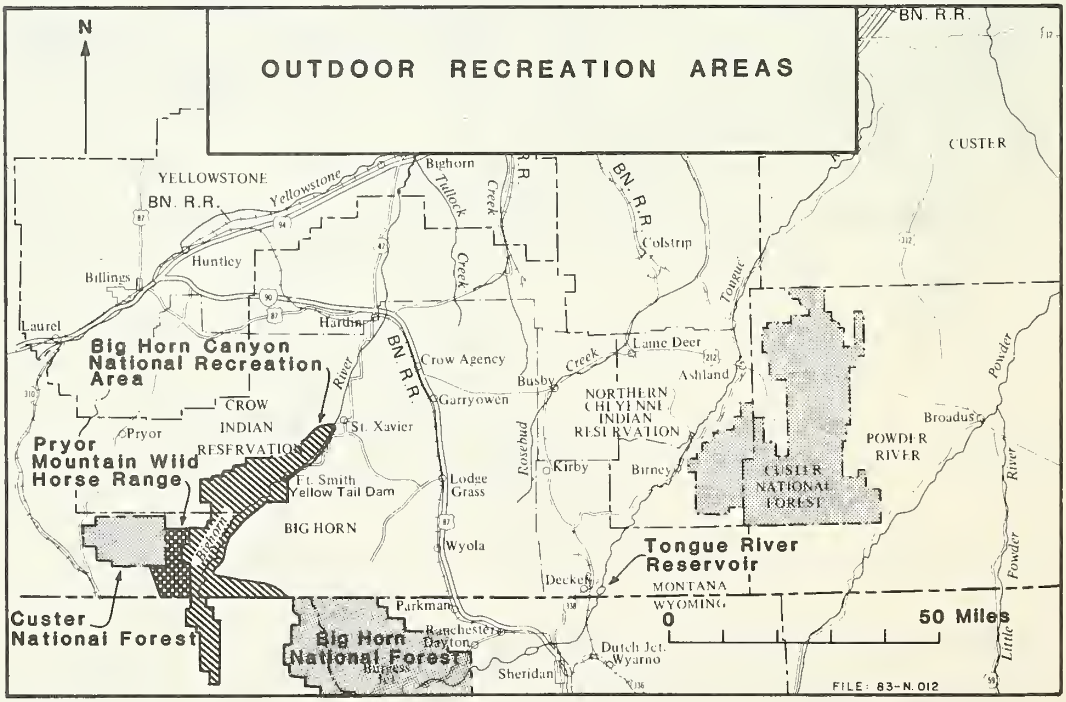


FIGURE II-18

Within a day's drive of the mine are a number of public recreation areas. The largest is Big Horn National Forest, which lies mostly within Wyoming.

in Bighorn National Forest reach capacity on weekends. In the Cloud Peak Primitive Area, foot trails are traveled heavily, more than anywhere else in Bighorn Forest. At the Bighorn Canyon National Recreation Area, where an estimated 77 percent of visitors come from Wyoming and Montana, camping and boating sites reach capacity during five to six weekends a year (National Park Service, 1981).

CULTURAL RESOURCES

Cultural resource surveys conducted in 1972 (Fredlund and Fredlund) and 1975 (Wirth and Associates) yielded inventories of the entire Tract III area (fig. IN-1). The prehistoric remains identified include porcelanite quarry sites, habitation sites, rock shelters, lithic scatters, rock art sites, stone ring sites, and observation/hunting blind sites. Several of the sites were collected and tested and others (24BH149 and 24BH1728) were partially excavated. There are no recorded prehistoric sites within the application area. Several prehistoric sites are located in nearby areas but they are not eligible for nomination to the National Register of Historic Places. No sites were identified that might have religious signficance as defined by the Native American Religious Freedom Act.

Although the region has a colorful history associated with the opening of the frontier (trading posts, forts and battle sites), the Absaloka Mine area is dominated by sites of later periods associated with homesteading and settlement. Six historic sites (five homesteads and Second Sarpy School) are located in the application area but none are considered eligible for the National Register. Other historic sites are located nearby, but they, too, have been classified as not eligible.

AESTHETICS

A rolling patchwork of rangeland, ponderosa pine woodlands, and dry cropland covers the Absaloka Mine area. Cutting the rolling topography are shallow draws that grow with thickets of lush plants. The dominant features of the landscape are dark green, irregular groups of ponderosa pine. Overall, the scenery is pleasing and interesting.

The landforms of the life-of-mine area are mostly subtle. The only exceptions are nine groups of sandstone outcrops on the eastern side of the life-of-mine area. The outcrops rise abruptly from treeless grasslands. Some form 20- to 40-foot colored pedestals, visible in places for a mile or more.

Few structures predating the mine lie in the life-of-mine area. Those present--barns, fences, houses, outbuildings--were built for ranching and farming. The structures blend with the rural agricultural surroundings.

The landscape of the mine area is common in the plains region on the eastern side of the Rocky Mountains in Montana. Some nearby areas are less scenic--the flat agricultural lands between the Bull Mountains and the Yellowstone River. But many areas are more scenic--the Little Wolf Mountains, Bighorn Mountains, Yellowstone River, and the Bighorn Canyon and River (Westmoreland Resources, 1983, bk. E). The more scenic terrain offers denser vegetation, rougher topography, and more varied colors.

The mine area is closed to the public and can be seen only from the county road around the mine border. Even on the road, pine stands and hills hide most of the minesite.

To date, the Westmoreland has disturbed about 1,000 acres, 650 of which have been excavated for mining. Within the mine, the impacts of the mining are obvious: giant machinery, deep mine cuts, spoil piles, the coal plant, and the railroad.

The company has so far reclaimed 300 acres. The reclaimed lands look like rolling grass-covered hills, without ponderosa pine woodlands. The reclaimed topography is similar to what existed before mining, but the vegetation is, at the present stage of reclamation, much less diverse.

Chapter III

IMPACTS OF WESTMORELAND'S PROPOSAL

This chapter covers 19 topics, presenting subject by subject the impacts--mostly unavoidable--that could be caused by the application and life-of-mine plans. At the start of each topic is a summary of the major impacts anticipated to be caused by the mine plans. Following the summary is a detailed discussion of the impacts. Each section ends, when appropriate, with a list of "mitigating measures," or actions that could be taken to reduce or eliminate the mine's projected adverse impacts.

GEOLOGY

> Summary of Impacts: Throughout the mine area, some erosion and sedimentation of reclaimed lands would be unavoidable. The two permanent impoundments proposed to replace the springs destroyed or dried up by mining would probably function as intended with long-term maintenance. Moderate problems with drainage system stability may eventually arise.
>
> The company's application plan would establish a postmining rootzone that is acceptable for plant growth. Some of the rootzone spoil could contain elevated levels of molybdenum, which in turn could cause a copper-molybdenum imbalance in forage.

Topography and Geomorphology

Geomorphic impacts under the proposed mine plan would be moderately significant. The two proposed permanent impoundments may lead to drainage stability and sedimentation impacts. Unless the impoundments receive regular maintenance, the useful life of the features would probably be less than an estimated 100 years. It is significant to note, however, that the impoundments would probably function and have a useful life comparable to other similar structures in southeastern Montana.

In the application area, the loss of springs and the destruction of the current ground water system (see Hydrology), in conjunction with expected increased runoff from the postmining surface, would probably establish a more definable surface drainage network above the proposed permanent impoundments than what now exists.

Under the life-of-mine plan, geomorphic impacts would probably be similar to those of the proposed plan. The greater drainage density created naturally on the reclaimed surface, along with the elimination of an additional ten springs, would result in increased erosion in the coulee bottoms and sporadic, slightly increased sediment loads to East Fork Sarpy Creek. These impacts would require possibly several decades to centuries to fully develop.

Unavoidable erosion and sedimentation on the reclaimed surface would result from the disturbance of soils, grading and compaction of the post-mining surface, and increased water runoff. These problems are typical of any surface mine in a semiarid environment, and would last until hydrologic stability is reestablished.

Mineral Resources

Under the proposed mine plan, approximately 65 million tons of coal would be mined from an additional 573 acres within Tract III. Some coal would not be recovered, owing to the limits of present technology (U.S. Department of Interior, 1977).

The coal mined under the life-of-mine plan would amount to 30 percent of the total economically recoverable reserves in Tract III, and about 1/2 of 1 percent of the estimated strippable reserves in the northern Powder River coal basin. Mining would recover about 90,500 tons/acre--about average for strip mines in southeastern Montana.

Other Geologic Impacts

The existing stratigraphy down to the lowest coal seam mined would be replaced by a mixed mass of broken rock with greater porosity. The existing stratigraphy, however, is not unusual and has no intrinsic value.

Mining would not interfere with development of other minerals: none of significance are known at the minesite. Any possible reserves of oil and gas would occur in rocks beneath those to be mined. Clinker would be disturbed by mining, but this material is common throughout the region. Mining would not create any geologic hazards of consequence. Coal fires would be a potential hazard during mining; but the hazard would be minor, because Westmoreland is committed to extinguishing fires when they occur. After reclamation, coal fires would be highly unlikely.

No paleontological resources of importance are known to exist in the rocks of the Fort Union formation that would be mined.

Overburden

Overall, Westmoreland's proposal would establish a postmining rootzone that would be acceptable for plant growth. (The rootzone includes the top 8 feet of replaced overburden, or spoil.) However, the company should take special steps to avoid a potential problem caused by molybdenum.

Sodium

The major concern with sodium at the Absaloka Mine is in the interburden. The interburden is generally mixed with overburden during excavation to expose the Robinson coal seam. At this time the dragline rehandles Rosebud-McKay overburden and interburden, placing it at the top of the spoil piles. Westmoreland's experience to date has indicated effective mitigation of sodium levels by interburden mixing with overburden (Westmoreland Resources, 1983).

In the northeastern part of the application area, the company would be mining the Robinson coal only because the Rosebud-McKay has burned out. Although no overburden cores were taken in this area, the lower part of the overburden here is probably similar to the interburden farther west (i.e. sodic). Since only one seam would be mined in this area, less rehandling of material, and therefore less mixing, would take place. This would increase the chances of sodic spoil being placed in the rootzone.

While Westmoreland's stripping procedures may provide a generally favorable spoil surface (i.e. rootzone), small to moderate areas of sodic material still could end up in the rootzone. Even where this occurs, however, no serious impacts are anticipated. The soils proposed for reclamation, although mostly sandy, are of good chemical quality. In addition, the overburden/interburden mixture is not dominated by swelling clays, and would probably maintain good hydraulic conductivity (water movement) over time. Dollhopf et al. (1980) have shown that in similar situations little, if any, upward salt migration occurs. Therefore, no soil or plant degradation is expected to take place.

Molybdenum

Molybdenum levels slightly exceed the proposed 1983 Department of State Lands suspect level in about half of the overburden samples tested. The Department requires testing for molybdenum because the metal can lead to molybdenosis in livestock--a disease caused by a copper-molybdenum imbalance often attributed to high molybdenum concentrations in forage. Although molybdenum levels in some application area cores exceed the proposed suspect level, molybdenosis would not necessarily occur.

The difficulty of any projection of molybdenosis stems from the complexity of molybdenum toxicity. This complexity, in turn, stems from several factors. Research indicates that the disease arises not only from excess molybdenum, but also from low levels of available copper and high sulfate-sulfur concentrations in forage (Gough et al., 1979). The most critical parameter is the copper:molybdenum ratio in forage. Plant uptake of molybdenum and copper is complicated by soil and environmental factors. The levels at which molybdenum in the soil would cause molybdenosis in cattle cannot, therefore, be specified precisely.

The company's reclamation plan would greatly decrease the chance of molybdenosis in most cases. First, the company proposes to place at least 3 feet of chemically favorable soil over the spoil. This would decrease the amount of molybdenum uptake. Second, few leguminous plants--known molybdenum accumulators--are proposed for the revegetation seed mixtures. This would reduce the amount of molybdenum in forage. These two measures would probably reduce the chances of molybdenosis to a low level, but not altogether eliminate the potential for the disease. (See Mitigating Measures.)

Blooms of two leguminous plants--yellow and white sweetclover--periodically occur in reclamation areas. Wind-transported seed from adjacent fields is usually the source of these plants. The sweetclovers are known molybdenum accumulators and cattle grazing predominately on this vegetation could suffer from a metabolic imbalance resulting in molybdenosis (Erdman et al., 1978). This may be especially true on revegetated mine areas, where legumes, such as the sweetclovers, exhibit a tendency to accumulate even higher concentrations of molybdenum than legumes growing on native range or cultivated fields (Munshower and Neuman, 1978). Since there appear to be no effective methods of controlling invading sweetclover on reclamation areas, it is important to add copper supplements to the diet of grazing livestock. (See Mitigating Measures.)

Mitigating Measures

Two measures of reducing the chances of molybdenosis, mentioned earlier, are already included within the company's reclamation plan. To further lessen the chances of the disease, Westmoreland could ensure that mineral salt blocks contain copper salts so that cattle have an additional supply of copper in their diet to prevent symptoms of molybdenosis. The company could also inform future landowners of the reclaimed areas of the necessity to use copper supplements as a preventative measure.

HYDROLOGY

Summary of Impacts: Eight springs would be removed by mining in the application area. At least three other springs would probably cease flowing during mining due to associated disturbances and lowered water tables. Three of these eleven springs are apparently perennial surface water supplies. The proposed plan to restore the surface water supplies would be partially successful; therefore, the loss of springs would be permanent (with the possible exception of spring 12), reducing the mine area's surface water supply. In the life-of-mine plan, another 10 springs would be lost. Because the springs will be replaced with two permanent impoundments, impacts to the local hydrologic system would be minimal. No impacts are likely to occur to East Fork Sarpy Creek.

Surface Water

The most significant impact on surface water in the application area would be the removal of eight springs in the North Coulee drainage. (See Ground

Water.) Spring numbers 4, 5, 7, 8, 9, 10, 11, and 261 would be destroyed. Of these eight springs, two are considered perennial surface water sources. Springs 12, 13, and 277 would probably cease flowing as a result of a lowered water table (fig. II-2). Spring 12 is also considered a perennial water supply and is the largest spring in North Coulee. Other springs nearby would be affected negligibly, if at all. After mining, it is conceivable that seepage from one of the proposed permanent impoundments may recharge spring number 12, thereby offsetting to an unknown degree the loss to mining of this spring's present recharge area.

The life-of-mine plan would remove an additional 10 springs: numbers 13, 14, 15, 271, 272, 273, 277, 24, 25, and 29. The flow of springs 20 and 260 would markedly decrease or cease. (See Ground Water.)

Because most or all of the affected springs flow only a short, if any, distance down the coulee, mining's impact on surface water would be limited to the loss of the springs themselves. No direct impact during mining is likely on the intermittent surface flow of the Sarpy Creek system.

Another impact on surface water during mining would be the loss of surface runoff from the mining area. State and federal regulations require Westmoreland to limit surface discharge from mining areas. Accordingly, the company proposes to construct impoundments to control surface runoff from the mine. Under both the proposed and life-of-mine plans, the calculated loss of surface runoff to the Sarpy Creek basin would amount to less than 1 percent. The actual loss, however, would be less: Most or all runoff from North Coulee is probably lost to infiltration and evapotranspiration. The same losses would occur during mining.

After mining, surface runoff from the reclaimed surface is expected to increase by a measurable, although unpredictable, amount (Lusby and Toy, 1976). The total increase in surface flow would amount to a negligible change in the runoff of the East Fork drainage basin. Reclamation under the life-of-mine plan may eventually increase peak runoff flow to the East Fork of Sarpy Creek, but at the expense of base flow. This would not cause any measurable impacts to downstream agricultural operations.

Surface water would be impounded by sedimentation ponds in the application area. Total dissolved solids (TDS) in surface water draining to the East Fork of Sarpy Creek are not expected to increase significantly, because data collected by Westmoreland indicate that TDS concentrations in the existing main sediment pond are within the range of concentrations of surface water for adjacent, unaffected tributaries. The impact to the quality of water in the main stem of East Fork, due to proposed mining activities, would thus be insignificant.

The Montana Department of Health and Environmental Sciences has issued two surface water discharge permits to Westmoreland. The company, however, rarely discharges from the mine area. Moreover, periodic water quality monitoring to date has revealed no water quality problems.

Direct and indirect water consumption due to the mine would not conflict with other uses of water in the area. The Absaloka Mine now consumes about 200 acre-feet of water per year, most of which is obtained from the deep Madison aquifer. At the full coal production level of 10 million tons per year, consumption at the mine would reach about 250 acre-feet per year from the same source.

Westmoreland would build two permanent impoundments and drill two wells to replace springs lost by mining in the application area. The impoundments would be designed to contain surface runoff from reclaimed mined lands, thereby providing water for livestock and wildlife for several months of the year. Both of the impoundments would be constructed initially as sedimentation ponds for use during mining. Analyses indicate that under dry to average runoff conditions, the spring snowmelt expected to fill the smaller pond would evaporate or be lost to seepage within one or two months.

The other impoundment would be designed retain snowmelt runoff through the summer months under all but the driest climatic conditions. Based on available data, there is an estimated 70 percent probability that water would be in the pond through the summer every year. It is possible that no perennial surface water sources for livestock and wildlife would be present on the mined area after mining. (See Land Use, Vegetation, and Wildlife.) Fewer seasonal water sources would exist.

The impoundments would probably require regular maintenance to keep functioning properly. Without regular upkeep, the impoundments could be rendered inoperative by sediment deposition within 100 years. Whether postmining landowners would indefinitely maintain the impoundments is questionable. However, it is notable that most of the springs in Tract III appear to have been developed and maintained by ranchers over the past decades. With or without mining disturbances, these spring developments would also have to be maintained in the future if the springs were to remain as useful water sources for livestock and some wildlife species.

The postmining surface water drainage network proposed by Westmoreland for the application area would be similar in design to the premining drainage system. The reconstructed drainages would have a generally concave configuration that would limit the potential for excessive erosion. The initial reconstructed density of the postmining drainages would be slightly less than the present system and thus may not provide adequate avenues for surface runoff. This would lead to increased erosion and sedimentation as the drainages develop their own runoff networks.

Reclamation under the life-of-mine plan may eventually result in increased total suspended sediment concentrations in the East Fork of Sarpy Creek. (See Geology, Geomorphology.) The extent and the timing of the increase is uncertain. Whether the increase is avoidable under the very best reclamation practices is also uncertain.

Ground Water

The most serious impact on the ground water system from application area mining would be the destruction of the ground water flow system which supports numerous springs in North Coulee. (See Surface Water.) This impact would probably be significant, because it would reduce ground water flow within the North Coulee system and lower the ground water table. These conditions and a predicted general lowering of the coulee bottom water table may be offset by seepage from one of the permanent impoundments, which would be constructed partially on unmined surface. Seepage would be lost partially to underlying spoil and partially to the remaining coulee bottom sediments beneath the pond. The seepage moving through unmined coulee bottom sediments would flow down-coulee beneath the dam and eventually toward spring 12 (fig. II-2). To the extent that this occurs, therefore, spring 12 may recover after mining. Whether spring 12 would ever again be a perennial water supply, however, is unknown, although the coulee bottom water table may be close enough to the surface that spring 12 could be made perennial by deepening the present excavation at the spring. Water quality would probably be at least as good after mining as before.

The ground water system would be most affected at the head of North Coulee, where about two-thirds of the total drainage area would be destroyed by mining. Impacts would decrease with increasing distance down the coulee (away from the proposed mine area), because of the increasing importance of the water contributed by the undisturbed ground water basin, the diminishing influence of pit drawdown, and because a significant amount of the Rosebud-McKay clinker would not be disturbed by mining. Because North Coulee provides so little water to the East Fork of Sarpy Creek system, however, no hydrologic impact on the East Fork of Sarpy Creek would result.

Mining in the life-of-mine area would cause more impacts on the East Fork of Sarpy Creek ground water basin, but these are not anticipated to be significant. A 1,000-foot section in the northeast corner of the life-of-mine area would come within several hundred feet of the East Fork of Sarpy Creek valley floor. Induced ground water flow that may occur from the alluvial ground water system toward the mine pit in this area is estimated to be less than 10 gpm. This minor flow rate would cause little or no water level declines in the alluvial ground water system.

Hundreds to thousands of years would be required after mining for ground water systems in the spoil (replaced overburden) to re-equilibrate to approximate premining conditions. Postmining ground water flow through the mine spoil would most likely not reestablish the springs removed by mining. Ground water moving through the spoil would probably flow down the base of the mine floor, which is the structural base of the Robinson coal. Ground water entering the spoil from unmined coal and overburden to the south would eventually enter undisturbed units to the north and east. A ground water flow system, possibly similar to the present system, would be established after many years of recharge to the spoil from the adjacent undisturbed strata and from infiltration of precipitation. Accurate determination of the time necessary for aquifer reestablishment is beyond the current state of knowledge regarding postmining hydrologic systems.

Postmining ground water occurrence in the reclaimed coulees may help sustain the proposed vegetation and allow for at least a seasonal ground water table near the coulee surface. A primary determining factor would be the permeability of the underlying spoil. If the spoil is relatively permeable, spring runoff and snowmelt saturating the reclaimed coulee-bottom soils would be lost through downward percolation into the spoil. This may create seasonal drying of these soils. However, if the underlying spoil is relatively impermeable, or if Westmoreland compacts the coulee bottom spoil, percolation losses of this ground water could be minimized and the reclaimed coulee bottoms may at least seasonally contain a shallow ground water table.

Westmoreland's drainage bottom reclamation plan includes specific measures that would increase soil moisture in the coulee bottoms and therefore assist reestablishing vegetation. (See Vegetation.) These measures include steeper northeast facing slopes along the coulees to promote accumulation of drifting snow and to reduce excessive summer drying of the soils; placement of six feet of appropriate soil material in the incised coulee bottoms; and construction of a scoria infiltration blanket on terraces alongside coulee bottoms to promote infiltration. All these measures would serve to enhance soil moisture in reclaimed coulee bottoms.

Preliminary ground water quality data are available from four monitoring wells completed in spoil (Westmoreland Resources, 1983). These data indicate that spoil water quality is similar to ground water quality in undisturbed Robinson coal. Ground water in the spoil is predicted to range from 2,600 to 2,900 mg/l over time as more ground water resaturates the spoil.

The increased spoil TDS concentrations would have minimal, if any, impact on the East Fork of Sarpy Creek hydrologic system. There are two reasons for this: (1) spoil water TDS would exceed the East Fork of Sarpy Creek alluvial ground water TDS by only a small increment and (2) the rate of spoil ground water flow through the application area, if it ever approaches the current combined overburden, Rosebud-McKay, and Robinson ground water flow rates of 12 acre-feet per year, would be minor compared to the average flow rate of 102 acre-feet per year in the East Fork alluvium. Spoil water quality is not expected to affect deeper aquifers in the application area.

Three stock and domestic wells, numbers 303, 376 and 377, would be removed by mining in the application area. Stock and domestic wells located within the life-of-mine area that would be removed during mining are listed in table III-1. Stock and domestic wells located adjacent to the life-of-mine area (in which the water levels may be lowered as a result of local ground water level declines), are also listed in table III-1.

Westmoreland also proposes to use wells completed in strata underlying the Robinson coal as alternative water sources. Ground water from the sub-Robinson strata is commonly used in the Tract III area for domestic and stock supplies and would not be disturbed by mining.

Several wells have been completed in sub-Robinson strata by Westmoreland (Westmoreland Resources, 1983). Sustained yields and water quality of these wells are adequate alternatives for removed or potentially affected stock and domestic wells. Sub-Robinson wells could also be used to supplement the proposed impoundments as alternatives for the springs which would be removed by mining.

TABLE III-1

Stock and Domestic Wells Affected by Mining In the Life-of-Mine Plan

Wells Removed	Wells Possibly Affected
337A	327
303A	364
376A	365
326A	366
372	373
360	317
337	375
336	306A
335	
374A	
318A	
316	
315	
314	
298A	

Source: Westmoreland Resources, 1983.
Note: A = Abandoned Well
For the location of these wells, see fig. II-3.

All three water sources, the existing springs, the proposed impoundments or sub-Robinson wells, would require perpetual maintenance to remain as viable surface water supplies in the future, whether or not mining occurs.

Mitigating Measures

To reduce water losses to percolation, Westmoreland could compact the spoil in the reclaimed coulee bottoms and underneath the proposed impoundments.

SOILS

Summary of Impacts: The disturbance area contains excessive amounts of fine sandy loam soil. If salvaged and replaced without selective handling, soil losses could occur in some localized areas, especially on the steep drainage side slopes. Coulee bottom soils are often wet, and if salvaged when wet, would cause severe compaction and total deterioration of soil structure, which could adversely affect revegetation of coulee bottoms.

Soil Quantity and Quality

Westmoreland is proposing to salvage approximately 1,817.3 acre-feet of soil from the disturbance area, providing a total average cover depth of about 38 inches on the reclamation areas (table III-2). The company plans to direct haul (from freshly disturbed areas to reclamation areas) about 90 percent of its soils. This would minimize impacts on soil quality, especially the degradation that occurs when soils are stockpiled.

For the most part, the soils at the Absaloka Mine are chemically favorable. However, the Alice and Nelson soils, which make up about 65 percent of the application area (73 percent of the proposed salvage volume), are sandy. Sandy soils such as these are erosive because of their very fine sand content and are more susceptible to drought because of their low water-holding capacities. The potential for rill and sheet erosion on these soils is greatest before vegetation establishment, although straw mulching (at a rate of 1 to 2 tons per acre) prior to seeding greatly reduces the erosion potential.

Soil Handling and Erosion

In its reclamation plan, the company plans to selectively salvage and replace specific soils in two cases. Scoria and sandstone soils that contain varying amounts of gravels and cobbles, and are unsuited for the reclamation of grassland areas, would be replaced where ponderosa pine or skunkbush sumac revegetation is planned. Such soils are similar to those now supporting these types of vegetation. Coulee bottom soils would be direct-hauled to recontoured drainage bottoms within the reclamation areas. Previously at the Absaloka Mine, this procedure has resulted in first-year emergence of important drainageway species such as rose and snowberry.

Gully erosion has been observed in one reclaimed coulee bottom at the Absaloka Mine. Gullies could be expected to develop in the application area during reclamation. If not repaired in the early stages of development, significant soil losses could occur in these drainages. The potential for gully development would decrease after successful establishment of vegetation.

Rill and sheet erosion have also occurred in these drainage bottoms, but to a much lesser extent. This erosion could be somewhat mitigated by seeding the lowland drainage mixture immediately after soil replacement at one-third to one-fifth the normal rate. This low rate would also prevent excessive competition with the shrub seedlings.

The company's reclamation plan does not mention any other type of selective soil handling. Becasue of the large quantity of sandy soils in the application area, a number of problems may occur during and after reclamation.

One problem would stem from steep slopes. According to its reclamation plan for drainages, Westmoreland would have a few side slopes that are approximately 3:1 (33 percent) and 4:1 (25 percent). It is likely (without any additional selective handling plans) that these proposed slopes would be

TABLE III-2
Soil Resources to be Disturbed and Reclaimed in the Application Area

Soil Mapping Unit	Acres to be Disturbed	Percent of Total Area to be Disturbed	Proposed Total Salvageable Depth in Inches (topsoil/subsoil)	Estimated Salvage Volumes (acre-feet) Primary Lift (topsoil)	Secondary Lift (subsoil)	Total	Percent of Total Salvageable Volume	Primary Limiting Factors
Alice Fine Sandy Loam, 4-15%	52	9	12/48	52.0	208.0	260.0	14.3	None
Aquolls and Aquents, 0-35%	11	2	12/48	11.0	44.0	55.0	3.0	Water Table
Cushman Loam, 4-8%	19	3	12/28	19.0	44.3	63.3	3.5	Bedrock
Fort Collins Loam, 2-4%	4	<1	12/48	4.0	16.0	20.0	1.1	None
Fort Collins Loam, 4-8%	24	4	12/48	24.0	96.0	120.0	6.6	None
McRae Loam, 4-8%	2	<1	6/54	1.0	9.0	10.0	0.5	None
Nelson Fine Sandy Loam, 2-15%	321	56	12/28	321.0	749.0	1,070.0	58.9	Bedrock
Spearman Loam, 4-8%	5	<1	6/30	2.5	12.5	15.0	0.8	Bedrock
Thedalund Loam, 4-8%	1	<1	6/14	0.5	1.2	1.7	0.1	Bedrock
Thedalund Loam, 8-25%	74	13	6/14	37.0	86.3	123.3	6.8	Bedrock
Thedalund-Wibaux Complex, 8-15%								
Thedalund part	42	8	6/14	21.0	49.0	70.0	3.9	Bedrock
Wibaux part	18	3	6/0	9.0	0.0	9.0	0.5	Bedrock
TOTALS	573	100		502.0	1,315.3	1,817.3	100.0	

Source: Westmoreland Resources Inc., bk. D, vol. 5, 1982.

Note: Percentage figures following mapping unit names represent slope ranges where unit is found.

covered after mining with significant amounts of sandy soils. Although the sandy soils are labeled as "fine sandy loams," their very-fine and fine sand content, which is directly related to erodibility, is unknown. The steep side slopes should be considered high erosion hazard areas.

An additional soils problem could arise in coulees. As discussed earlier, Westmoreland would salvage the coulee bottom soils and replace them directly in re-created coulees in the reclamation areas. The coulee bottom soil type, labeled "Aquolls and Aquents," has a water table in some places that varies within 5 feet of the surface. Attempts to salvage wet soils, regardless of the equipment used, would lead to severe compaction and complete deterioration of soil structure. Draining these areas and allowing them to dry for a period of time appears to be the only way to reduce soil compaction and degradation. (See Mitigating Measures.)

Mitigating Measures

Westmoreland could reduce the erosiveness of the reclaimed soils by decreasing the amount of sandy soils proposed for salvage. (Refer to table III-2.) The Alice soil could be decreased from a total salvage depth of 60 inches to 48 inches. Similarly, the Nelson soil could be decreased from a total salvage depth of 40 inches to 24 inches. The Fort Collins soil is more favorable, owing to heavier texture, and its salvage depth could be increased from 60 inches to 84 inches. These salvage depth adjustments would still allow for an overall salvage and replacement depth of greater than 2 feet.

Westmoreland could also reduce the erosion hazard on the proposed steep drainage side slopes by selectively placing medium-textured soils (avoiding the fine sandy loams) where grassland vegetation is proposed.

Careful monitoring of rill and sheet erosion and gully development in the drainages would allow Westmoreland to take effective remedial action to prevent excessive soil losses.

The company could drain the coulee bottom soils and allow them to dry by digging a trench downstream of the coulee several weeks or months before soil salvage.

VEGETATION

> Summary of Impacts: Mining of the application area would destroy 573 acres of vegetation over 13 years. After revegetation, grasslands would cover 74 percent of the disturbance area compared to 35 percent at present. This would increase livestock forage production, although plant species diversity would decline. Agricultural land (cropland) and the closed canopy ponderosa pine forest would be eliminated. The amount of deciduous shrubs, trees, and vegetation beside ponds would decline substantially. Reestablishment of the open-canopy pine forest would probably succeed.

Revegetation would begin within 2 years after the initiation of each mining pass. Topsoil, mostly replaced by the direct haul method, would be plowed, seeded, and mulched. Westmoreland may need to modify soil replacement plans to reduce potential erosion. (See Soils.) Revegetation would increase the proportion of grassland on the application area from 35 percent at present to 74 percent after reclamation (table III-3). Agricultural lands would not be replaced. Amounts of deciduous trees, shrubs, and vegetation beside ponds would be substantially reduced (Westmoreland Resources, 1983, bk. H). In addition, the intricate premine mosaic of vegetation types would be greatly simplified. No threatened or endangered plants would be affected.

Grassland

With more grassland after mining, more total livestock forage would be produced. Postmining forage production would be raised further by the expected increase in productivity after reclamation. Short-term productivity of reclaimed grassland is generally higher than productivity of native grassland (Hofmann and Ries, 1980; Sindelar 1980). Factors contributing to this higher productivity include reduced plant competition, high productivity of species in seeding mixtures, generally increased availability of nutrients due to soil disturbance, and the comparatively poor condition of heavily grazed native rangeland. Productivity of reclaimed grassland probably declines over the

TABLE III-3

Disturbance Area Acreages of Premining and Postmining Vegetation Types

Premining Type	Acres	Postmining Type[1]	Acres
Grassland[2]	202	Grassland	422
Ponderosa Pine Forest	184	Ponderosa Pine	137
Deciduous Tree/Shrub and Riparian	28	Drainage and Aquatic	14
Agricultural		--[3]	
Small grains	66	--	0
Alfalfa Hay	88	--	0
Miscellaneous Disturbance	5	--[3]	0
TOTAL	573		573

Source: Westmoreland, 1983 (bk. H, ex. 7, p. 2; bk. H, ex. 9, pl. 1).

[1] The difference between some premining and postmining type names reflects the different classification schemes used by Westmoreland Resources.

[2] Includes disturbed grassland subtype.

[3] Agricultural and miscellaneous disturbance acreages would be converted during revegetation to other types.

long-term. Still, assuming proper range management and favorable climatic conditions, postmining productivity is expected to remain above premining levels.

The diversity of grassland plants after reclamation would be lower than the diversity at present. This is due to two effects: (1) cool-season species (species exhibiting maximum growth in spring and fall) reestablish more successfully than warm-season species (species exhibiting maximum growth in summer) and (2) most soil microsites would be lost during soil replacement. The proposed use of direct haul topsoiling and, in upland areas, a warm-season-species-dominated seeding mixture would partially compensate for the above effects. (See app. E.) Over the long term, invasion by nearby native plants would probably increase diversity to near premining levels.

Ponderosa Pine

Revegetation of the open-canopy ponderosa pine subtype would probably succeed. Westmoreland proposes to plant 500 seedlings per acre during reclamation. With a 4-year mortality rate for containerized seedlings of about 40 percent (M. Mitchell, Westmoreland Resources, personal commun., September 14, 1983), up to three-fourths of the seedlings could die and, after 4 years, the premining density would still be reached. Other studies (Hite, 1974; Orr 1977) indicate that allowing for 40-50 percent mortality is appropriate.

In the closed-canopy subtype, by contrast, the premining density of ponderosa pines would not be reached with proposed planting rates. This subtype would probably be eliminated. The long-term density of the trees in the closed-canopy type would be increased by volunteer ponderosa pines and seeds from planted pines. However, undisturbed ponderosa pine are not close enough to serve as significant seed sources. Moreover, natural seeding from planted pines would take several decades, assuming the seedlings survive until maturity and sites are favorable for seed germination and subsequent growth.

Drainage Bottoms

After reconstruction of drainages, channel bottoms would be surfaced with soil hauled directly from undisturbed drainage bottoms. Those areas not proposed for shrub and tree plantings would be seeded with the lowland grassland seed mixture and several sod-forming grasses (app. E). The direct-hauled soil would provide a source for snowberry and rose regeneration. Westmoreland's test plots indicate a good probability of shrub establishment with the direct-hauled topsoil.

After spreading topsoil and straw mulch, the company would plant shrub and tree seedlings, primarily plum and chokecherry, at a rate of 1,000 per acre (see app. F for proposed species). Jensen and Hodder (1979) found plum and chokecherry to be vigorous, spreading species with high (over 80 percent) 4-year survival rates. Much lower (40 percent) 5-year survival rates of plum were reported by Bjugstad et al. (1981).

The documented establishment of shrubs and trees on reclaimed land indicates that drainage revegetation has a reasonable probability of success. Moisture-conserving features of reconstructed drainages (See Hydrology, Ground Water) would further promote shrub and tree growth.

A major obstacle to revegetation success could be a dry year during seedling planting. Most woody species become established only during average to above average precipitation years (Bjugstad, 1984a). Use of straw mulch, which usually contains weed and/or cereal grain seeds, also poses potential problems. Sprouting weeds and cereal grain plants, strong competitors for water, would reduce the amount of moisture available for seedlings (Kay, 1980; I.B. Jensen, Western Reclamation, personal commun., February 2, 1984). Straw mulches also attract small rodents that can damage seedlings (Stoeckeler and Slabaugh, 1965). Unpredictable factors which would limit success are excessive erosion of channel bottoms, soil compaction and breakdown, and destruction of developing plants by wildlife or livestock.

Aquatic Vegetation

Westmoreland expects 7.5 acres of aquatic vegetation to become naturally established in or around reconstructed ponds in the northeast corner of the disturbance area. Plans call for supplemental planting of cattail, bulrush, and sedges "if necessary."

Proposed acreages of aquatic vegetation would not be attained. During a mean runoff year (Westmoreland Resources, 1983, bk. I), the reconstructed ponds would cover an estimated maximum of 3.7 acres. Pond water would increase surrounding soil moisture and associated vegetation for only several feet. Cattail and bulrush both require moist mudflats or shallow water for seedling development (George, 1963; Yeo, 1964; Linde et al, 1976). Roughly 3.8 acres would therefore be exposed to erosion or weed invasion. At best, species from adjacent revegetated grasslands would grow on this acreage. Also, although the area would not be used for grazing during the first 3 years after reclamation, cattle use may damage developing plants (Berg, 1956; Evans and Kerbs, 1977).

Life-of-Mine Area

Reclamation plans have not been developed for the life-of-mine area. Revegetation techniques used in the application area could be extended to the life-of-mine area. Similar results would be expected.

Mitigating Measures

- The proposed upland grassland seed mixture contains 60 percent warm-season grasses (app. E). Despite the high percentage, the highly competitive cool-season grasses in the mix (20 percent) may still dominate during revegetation. To promote diversity, Westmoreland could increase the proportion of warm season grass in the mix. In addition, where possible, favorable microsites could be identified and seeded with warm-season grasses.

- At the proposed ponderosa pine planting rate (500 per acre), Westmoreland would not restore closed-canopy ponderosa pine stands. To increase the density of some postmining stands, the company could increase the pine planting rate in small areas.

- To increase the survival rate of seedlings, the company could use containerized ponderosa pine and chokecherry seedlings wherever possible. Experience at the Absaloka Mine shows that bare-root stock has less than one-third the survival rate of containerized ponderosa pine seedlings (M. Mitchell, Westmoreland Resources, personal commun., September 14, 1983). Hite (1974) and Orr (1977) also report higher survival of containerized stock. Containerized chokecherry also survives better than bare-root stock (Jensen and Hodder, 1979).

- To improve revegetation success, ponderosa pine and shrub seedlings could be monitored for damage by wildlife or livestock. Protective measures (such as chemical repellents or fencing) and/or replanting may be required.

- To improve reestablishment of drainage bottom vegetation, drainages could be monitored for excessive erosion, and remedial measures taken where necessary. Suggested measures include sodding, planting additional shrubs, regrading, and retopsoiling.

- To reduce introduction of undesirable plants in deciduous shrubs and tree planting areas, Westmoreland could use the "cleanest" straw mulch available (least amount of weed and cereal grain seeds). The company could also consider alternative mulches such as clean native range hay, gravel, and wood fiber with a chemical tackifier. Use of these mulches would decrease or eliminate introduction of competitive plants and would not attract rodents.

- Introduced and/or invading plants may inhibit deciduous shrub and tree growth. Weeds could be reduced by applying a short-term soil sterilant or scalping (removing a small area of vegetation around each plant) during planting. Hoeing could also be used periodically during the first growing season.

- If below average precipitation occurs within the first few years after shrub and tree planting, watering could be used to increase survival. Irrigation substantially increased survival of plum, buffaloberry, and green ash in Wyoming studies (Bjugstad et al., 1981). Westmoreland could use reestablished wells to supply a trickle irrigation system patterned after Bjugstad (1984b) or Garcia (1979).

  Shrubs and trees could also be watered during planting. This would settle soil and reduce air pockets, increasing survival (J. Coenenberg, Western Energy Co., personal commun., February 6, 1984).

- Westmoreland could extend drainage bottom grasses (app. E) into areas where proposed aquatic vegetation would not grow. Selected sedges and Garrison creeping foxtail (plants adapted to wet soils) could be added to the seed mixture. Cattail seeds, collected from local sources, could be broadcast around reconstructed ponds. This would supplement natural invasion. (Long, 1981; A. Bjugstad, U.S. Forest Service, personal commun., February 23, 1984).
- Grassland seed mixtures include 1 percent shrub seeds (app. E). Establishment and survival of shrubs could be monitored and seeding rates adjusted accordingly.

AQUATIC ECOLOGY

Summary of Impacts: Aquatic habitat and associated organisms would be substantially reduced in the North Coulee's drainage area. This impact would be significant in the application area. However, this reduction would not be regionally significant. No threatened or endangered species exist in the North Coulee.

In two-thirds of the North Coulee's drainage area, mining would eliminate aquatic habitat and associated organisms. After reclamation, macroinvertebrates would repopulate the proposed impoundments. The change in the number of the water sources (see Hydrology) would probably reduce the numbers and kinds of aquatic invertebrates. The result would be a reduction in food organisms for certain vertebrate species, such as song birds, in the application area.

The most abundant organisms after mining, like today, would probably be the highly mobile (Hemiptera, Odonata and Coleoptera) and short-lived (Dipteran) organisms that prefer standing water. Organisms such as Simulium sp., Diamesa sp. (Diptera), and Hydropsyche sp. (Trichoptera), which prefer moving water habitats, would probably be eliminated, owing to the cessation of spring flows.

Over the long term, impacts could increase. Filling of the impoundments by sedimentation would eventually eliminate aquatic life altogether from the application area unless the ponds are maintained by the postmining landowner.

The impacts in the application area would not affect other nearby life systems. Removal of additional springs in the life-of-mine area would further reduce aquatic habitat and associated organisms, but, similarly, impacts would not be significant overall.

The aquatic ecology of the East Fork of Sarpy Creek would not be affected by the proposed plan. The effect on the creek in the life-of-mine plan, in which increases in total suspended sediment may occur, cannot be determined.

Mitigating Measures

To increase aquatic habitat after mining, the company could establish overflow ponds supplied by water from wells.

WILDLIFE

Summary of Impacts: Mining in the application area would temporarily force wildlife from, and destroy, 573 acres of habitats, including one great-horned owl nest. After mining, reclaimed lands would supply foraging areas for deer, turkeys, and sharp-tailed grouse. However, the change in water sources (with associated vegetation) and the decreased acreage of woody cover would lower habitat quality for deer, turkeys, grouse, waterfowl, and several nongame species. Also, decades would be required for reestablished ponderosa pines to supply adequate cover. Although mining would have significant impacts on many wildlife species on the application area, no regional effects are anticipated.

Impacts in the Application Area

Wildlife Habitat

Vegetation: Mining would destroy over a 13-year period 573 acres of existing wildlife habitats, mostly grassland, ponderosa pine, and agricultural types (table II-6). A small amount of the silver sagebrush type would also be destroyed, as would coulee bottom types which are important to wildlife. Reclamation of wildlife habitats (Westmoreland Resources, 1983, bk. G, vol. 3) would begin within 2 years after the initiation of each mining pass.

Postmining reclamation would more than double the amount of grassland on the proposed disturbance area. Alfalfa and wheat fields would be eliminated. Proportions of other premining habitat types would be reduced and the mosaic of wildlife habitats would be simplified. Most vegetation associated with surface water would be removed. Wildlife would find little cover in reclaimed pine forests until trees attain sufficient size, decades after planting. Cover would be further reduced if drainage bottom revegetation plans do not succeed. (See Vegetation.)

Water Sources: Mining would remove five water sources used by wildlife and interrupt flow to another offsite source. Three of these sources are considered perennial. (See chapter II, Hydrology). Proposals to provide water after mining require a commitment to long-term maintenance and contain unknown factors (table III-4). During most years, one seasonal pond, one perennial pond, and one well with a stock tank (May-October only) would supply water for wildlife. Negative impacts on wildlife would be exacerbated during years when the proposed perennial pond dries up. If the offsite pond again functions after reclamation (see Hydrology), wildlife would gain an additional, nearby water source.

TABLE III-4

Water Sources for Wildlife After Mining And Reclamation of the Application Area

Source	Water Availability	Comments	EIS Reference
Reconstructed pond	Seasonal (spring)	Regular, long-term maintenance required	Hydrology (Surface Water)
Reconstructed pond	Perennial (70% probability)	Regular, long-term	Hydrology (Surface maintenance required Water)
Well No. 1[1]	May-July	Pumping required; long-term operation unknown	Hydrology (Groundwater) Land Use (Grazing)
Well No. 2[1]	August-October	Pumping required; long-term operation unknown	Hydrology (Groundwater) Land Use (Grazing)
Offsite pond[2]	Unknown	May recover after mining	Hydrology (Surface Water)

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[1] Assumes that water would be pumped at only one location during each half of the grazing season.

[2] Associated with spring 12 which would cease flowing during mining.

Big Game

Mule Deer: Based on 1981 observations, the disturbance area cannot be considered mule deer winter range. However, the area contains a substantial amount (384 acres) of ponderosa pine and grassland habitat types, which are often used by wintering deer. The area also provides mule deer range and habitats during all other seasons. Mining would gradually force deer into surrounding suitable habitats.

Mule deer may return to reclaimed grassland habitat types as early as 2 years after mining. The reclaimed lands would provide attractive winter and spring foraging areas and may be especially important for forage during severe winters. In the long term, the quality of reclaimed grasslands would remain high, assuming proper livestock management.

Complete reclamation of coulee bottoms and ponderosa pine forests would take decades. During this period, the reduced thermal, escape, and reproductive cover would decrease the overall quality of deer habitat. Small areas of dense coniferous cover are an important component of winter thermal cover

(Thomas et al., 1979). The elimination of the closed-canopy ponderosa pine subtype (see Vegetation) would reduce winter thermal cover.

The simplified mosaic proposed for the postmining area and the loss of water sources and agricultural lands would provide lower quality deer habitat than before mining. Since deer use a variety of habitat types, the postmining arrangement would force deer to range farther to satisfy their needs.

Human disturbance of mule deer on reclaimed land would be minimal. As long as Westmoreland controls the surface, the prohibition of firearms and hunting may create a refuge that attracts deer during hunting season.

The overall effects on mule deer from temporary habitat destruction, displacement from the application area to nearby lands, and deterioration of habitats after mining would probably be small. However, the effects cannot be predicted accurately for the Tract III area. Regionally, mining would not affect mule deer populations.

White-tailed Deer: The effects of mining and reclamation on the small white-tailed deer population would be similar to those effects on mule deer. However, whitetails are more dependent on agricultural land for winter forage and shrub thickets for cover. Whitetails would have to travel farther to reach agricultural lands. The lack of dense woody cover would limit their use of reclaimed grassland. Successful shrub growth in coulee bottoms would encourage use of reclaimed areas.

Pronghorn: Pronghorn are rarely observed on the disturbance area. Mining's effect on the species would therefore be insignificant. In fact, increasing the amount of grassland in the disturbance area may improve habitat quality for pronghorn. Westmoreland's fences would allow for passage of pronghorn.

Other Mammals

Mining would have little effect on predator populations. Coyotes and badgers would find reclaimed grassland suitable for hunting. Other predators (bobcats, raccoons, weasels, skunks) that are more dependent on dense, woody vegetation would use reclaimed areas infrequently until planted trees and shrubs grow big enough to provide cover. Similarly, desert cottontails, porcupines, least chipmunks, and red squirrels that also depend on woody cover would also use the newly reclaimed areas less frequently.

Small mammal populations would be eliminated or displaced during mining. However, the dense, herbaceous cover of reclaimed grasslands would provide good habitat. Deer mouse, prairie vole, and other small mammal populations would recover within a few years after reclamation begins.

Upland Game Birds

Meriam's wild turkeys would probably return to feed in reclaimed grassland. However, the elimination of agricultural land, used for foraging, would reduce habitat quality. Water sources and acreage of dense, woody cover in drainages would be reduced. Several decades would be required to replace roosting habitats eliminated by mining. Ponderosa pine must grow to 40 feet or more to supply roosting sites (Boeker and Scott, 1969).

After mining, the loss of woody cover would reduce the quality of sharp-tailed grouse habitat. Trees and shrubs provide important cover for Montana sharptails (Ecological Consulting Service 1976a, 1976b; Bjugstad, 1976). In the short term, loss of woody cover would be partially compensated for by the dense, herbaceous cover and abundant forage of reclaimed grasslands. Adequate cover would eventually return as trees and shrubs mature. However, the acreage of woody cover would be permanently reduced.

Waterfowl

Loss of most vegetation around ponds would nearly eliminate the potential for waterfowl production. If the offsite pond does not recover after reclamation (table III-4), more habitat would be lost. Most waterfowl require dense emergent and/or shoreline vegetation for nesting and brooding (Anderson and Glover, 1967; Evans and Kerbs, 1977). Waterfowl, however, would use reconstructed ponds as resting areas.

Raptors (Birds of Prey)

Raptor hunting habitat may be slightly reduced during mining. Reclamation and the anticipated repopulation of the mined area by small mammals that serve as prey would make the effect temporary. Planted ponderosa pine would not be tall enough to serve as eagle or hawk nest sites for several decades. Proposed powerlines would be designed to prevent raptor electrocution.

Mining would destroy a great horned owl nest and may cause desertion of a nearby red-tailed hawk nest. Redtails, especially early in their reproductive cycle, may not tolerate disturbances near their nests (Jackman and Scott, 1975).

Songbirds

Grassland songbirds, such as meadowlarks and vesper sparrows, would be more abundant than forest species on the disturbance area for decades after reclamation. Planted pines would have to grow to sufficient size and density before birds such as red crossbills and black-capped chickadees would repopulate the area. Vegetation associated with perennial water, important habitat for solitary vireos, yellow warblers, rufous-sided towhees, and other songbirds, would be nearly eliminated.

Reptiles and Amphibians

The dense herbaceous vegetation and small mammal prey base of reclaimed land would meet most habitat requirements of snakes. Rattlesnake use, however, may be limited by a lack of rocky cover. Reconstructed ponds would supply habitat for amphibian species. The possible loss of the offsite pond and the unreliable water supply of the reconstructed ponds (table III-4) may reduce local turtle populations. (See Hydrology, Surface Water.)

Threatened and Endangered Species

Mining would not affect the occasional bald eagle or peregrine falcon migrating over the application area. Westmoreland would report future observations of threatened and endangered species to the Department of State Lands.

Life-of-Mine Impacts

Mining would remove about 2,096 acres of wildlife habitats in the life-of-mine area. Over half of these acres are in the grassland habitat type (table II-6). Six water sources and nine rock outcrops would be mined through, generally lowering wildlife habitat quality.

Mining would gradually force big game animals from the life-of-mine area. Relatively large amounts of habitat types used by deer and pronghorn would be destroyed. Reclamation plans have not been developed. Thus, long-term and regional effects on big game populations cannot be predicted.

Bird habitat would also be disturbed by mining. Ring-necked pheasant habitat along the East Coulee and three sharp-tailed grouse dancing grounds would be destroyed. One great horned owl nest and one red-tailed hawk nest would be removed. Mining would advance to within 0.25 mile of a red-tailed hawk nest and a northern harrier nest, creating a potential for nest desertion.

A small possibility exists that black-footed ferrets inhabit the prairie dog town. This town should be more carefully searched for ferrets prior to mine disturbance.

Mitigating Measures

To improve the quality of thermal cover for wintering mule deer, Westmoreland could increase the ponderosa pine planting rate in several 2- to 5-acre areas. Thomas et al. (1979) describe optimum mule deer thermal cover.

Westmoreland could establish rock and brush piles to increase postmining cover for reptiles and rabbits.

To provide potential nesting and perching sites for birds, several snags (dead trees) could be erected on reclaimed lands.

For improving sharp-tailed grouse habitat, Westmoreland could try to create new dancing grounds. Techniques described by Ecological Consulting Service (1976) could be used.

Westmoreland could improve proposed stock tanks for wildlife by adding overflow ponds, floating platforms, escape ramps, and, if necessary, by regulating cattle use. If both reconstructed ponds go dry (table III-4), wells at both stock tanks could be pumped. The company could increase wildlife use of reclaimed areas by keeping tanks full from March through November. (Pumping is now proposed for May through October. See Land Use.)

CLIMATE

Continued mining at the Absaloka Mine would not affect the climate. Particulate emmissions would remain at or near ground level, and total emissions would be too small to affect either precipitation or radiation balance.

AIR QUALITY

> Summary of Impacts: During maximum production, mining would cause significant impacts on present air quality. Total suspended particulate (TSP) concentrations would increase, especially close to mining and the processing facilities. But the Montana and Federal Ambient Air Quality Standards would not be exceeded.

TSP would be the only pollutant of major concern emitted by mining. Most TSP would be noncoal dust from (1) overburden and topsoil removal and (2) haul road traffic and repair. These activities would produce more than 70 percent of the 1,519 tons of particulate emitted annually. Wind erosion of exposed areas would also produce a significant amount of particulate: 198 tons, or 13 percent of the total, per year (table III-5).

The coal processing facility would emit small quantities of coal dust. The dumping, crushing, conveying, and loading of coal would produce about 187 tons of coal dust per year, about 12 percent of total particulate emissions.

The particulate emitted by the mine would consist of large particles that fall to the ground close to the source. TSP concentrations would therefore decrease rapidly with increased distance from the mine. Overall, at the mine, TSP concentrations are expected to increase over present levels (see chap. II, Air Quality), but the concentrations would still be well below all applicable standards.

Emissions expected from the Absaloka Mine would be similar to other large open pit operations. For comparison, during 1980 and 1981 the Decker mining complex in southeastern Montana recorded a maximum annual geometric mean TSP concentration of about 37 ug/m^3. Coal production during the 1980-81 period equaled the maximum production projected for the Abasloka Mine (10 million tons per year). Westmoreland must use dust control practices similar to those

TABLE III-5
Particulate Emissions

Source	Extent	Emission Factor	Emissions (tons/year)	Control Strategy	Percent Control	Controlled Emissions (tons/year)
Topsoil Removal	532,400 yd^3	0.38 lb/yd^3 [a]	101	-		101
Overburden Removal	41 x 10^6 yd^3	0.03 lb/yd^3 [a]	615	-		615
Coal Removal	11 x 10^6 tons	.002 lb/ton[a]	11.6	-		11.6
Overburden Drilling	20,800 holes	1.5 lb/hole[a]	15.6	water injection	90	1.6
Coal Drilling	20,800 holes	0.22 lb/hole[a]	2.3	water injection	90	0.2
Overburden Blasting	520 blasts	37.5 lb/blast[a]	9.8	-		9.8
Coal Blasting	520 blasts	26.25 lb/blast[a]	6.8	-		6.8
Traffic Haul Roads	460,000 miles	6.8 lb/vmt[b]	1564	dust suppressent	85	235
Truck Dump	11 x 10^6 tons	.013 lb/ton[a]	71.5	-		71.5
Crushing						
Primary	11 x 10^6 tons	.02 lb/ton[a]	110	enclosed	99	1.1
Secondary	11 x 10^6 tons	.06 lb/ton[a]	330	enclosed	99	3.3
Conveyors	11 x 10^6 tons	0.2 lb/ton[a]	1100	partially covered	90	110
Coal Storage	1.6 ac 2.6 m/sec	0.9 u lb/acre hr[a]	16.4	enclosed	99	0.2
Train Loading	11 x 10^6 tons	.0002 lb/ton[a]	1.1	retractable shut	50	0.6
Exposed Area	330 acres	1200 lb/acre[b]	198	-		198
Access Road Traffic	62,800 miles	4.4 lb/vmt[b]	138	dust suppressent	85	20.7
Haul Road Repair	16,640 hours	16 lb/hr[a]	133	-		133
TOTAL						1,519

Note: vmt = vehicle miles traveled; u = wind speed

[a] written commun., Pat Driscoll, Montana Air Quality Bureau

[b] Department of State Lands, 1979, p. III-9

used by the Decker complex, according to the air quality permit (1418) approved by the Montana Air Quality Bureau on June 11, 1980. Therefore, the TSP concentrations resulting from the Westmoreland operation are expected to be similar to the levels at the Decker complex.

Internal combustion engines, diesel and gasoline, would emit 445 tons of nitrogen oxides, 103 tons of carbon monoxide, 35 tons of sulfur oxides, 34 tons of hydrocarbons, and 22 tons of particulate annually. The air quality would not be measurably affected by these emissions.

ECONOMICS

Summary of Impacts: Impacts to the local economy would not be significant. Any new mine jobs resulting from increased coal production are likely to go predominately to Crow Indian workers. At maximum, 140 more jobs would be created at the mine. In the county, total employment is projected to continue to grow at current, modest rates through the life-of-mine period. At full production, the mine's payroll would increase from $4.1 million to $8.7 million per year.

Employment

The mine today employs 125 workers. Under Westmoreland's application, employment would rise by 1984 to 155 workers, enough to operate the mine at the 5-million-ton-per-year production level. In the life-of-mine plan, the company would employ a maximum of 265 workers, the number needed for the full production level of 10 million tons per year. Most new employees are expected to be members of the Crow Tribe (David W. Simpson, Westmoreland Resources Inc., written commun., November 19, 1982). The increases in employment, if they occur as assumed by Westmoreland, would lead the projected economic recovery in the county in 1984.

The mine, together with other economic factors, would steadily increase Big Horn County employment in the years ahead. Exact projections of employment, however, require several assumptions. The first is that existing trends in most basic industries continue. Another is that full production would be reached at the Absaloka by 1997 and the Decker area mines by the late 1980s. Under these assumptions, employment in agriculture is projected to fall slightly through 2015, reflecting a small drop in the number of agricultural proprietors. Meanwhile, steady growth in the other basic industries, particularly government employment associated with the reservations, would gradually erode agriculture's dominance as the county's economic base.

Total employment is projected to grow from its low of 4,430 jobs in 1984 to 4,893 jobs in 1990, an increase of 10 percent (Mountain West Research-North Inc. [MWR-N], 1983, p. 4-55). In both the 1990s and in the first decade of the twenty-first century, total employment is projected to increase by 14 percent, followed by a 7 percent increase between 2010 and 2015, reaching 6,834 jobs in 2015 (MWR-N, 1983, p. 4-55). (For additional detail on employment, see the 1983 report by Mountain West Research-North.)

Income

Projections of personal income follow the same pattern as employment projections. The 1 percent employment decline between 1980 and 1984 would produce about a 3 percent decline in total personal income. Because the population would continue to grow over the period, per capita income would decline even more, by about 6 percent (MWR-N, 1983, p. 4-56).

The growth in employment that is assumed to occur after 1984 would increase total personal income. From its 1984 low, total personal income would climb by 12 percent by 1990. During the 1990s, it would grow by 15 percent, and between 2000 and 2015, by 22 percent (MWR-N, 1983, p. 4-56).

Population increases would partially offset this total income growth: Per capita income would rise, but not enough to reach the 1980 level until about halfway through the 1990s (MWR-N, 1983, pp. 4-53 and 4-56). This rise in per capita income would steadily continue at about 0.1 percent per year, through 2015, and per capita income would be about 11 percent higher in 2015 than at the 1984 low point.

Mining would add millions to tribal revenues through royalties. At currently negotiated rates, the mine would pay as much as $5.7 million to the tribe in a single year and $45 million overall during the life of the proposed permit. In the life-of-mine plan the amount paid to the tribe would rise to as much as $71 million per year and $308 million overall. (For additional detail on income, see the 1983 report by Mountain West Research-North.)

SOCIAL CONDITIONS

> Summary of Impacts: The continued operation of the Absaloka Mine would not cause significant impacts to the social organization, population, or housing of Big Horn County, the Crow Reservation, or the Northern Cheyenne Reservation.

Big Horn County

Social Organization

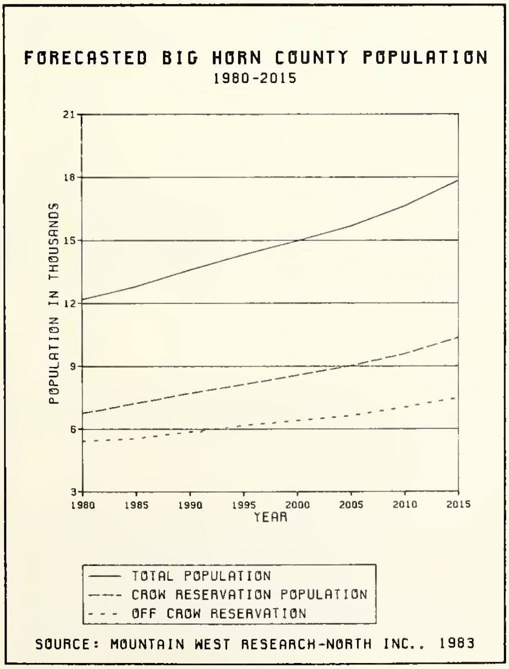
The Absaloka Mine's continued operation, at present or increased employment levels, would have no effect on social organization in Big Horn County. The mine's operation would allow the continuation of some recent social developments, such as ties of local government, business, and individuals with outside agencies and people. The operation would also allow continued occupational diversity and encourage local governments to sustain planning and coordination efforts, internally and with outsiders (MWR-N, 1983). The mine's operation would also have little effect on the Crow Tribe's social organization (The Crow Tribe of Indians and American Indian Technical Services, 1983). Population

Population

In the future, Big Horn County's population is expected to increase moderately, rising 11.5 percent above the 1980 level by 1990, 22.9 percent by 2000, 36.5 percent by 2010, and 46.5 percent by 2015 (fig. III-1 and table III-6). These projections assume that the future holds no major new development, that is, existing mines operate according to their mine plans.

None of the nonreservation areas' population is projected to increase as rapidly as the county population as a whole. Hardin would grow faster than the other two subcounty areas (table III-6), but by the year 2015 the town's 37.1 percent population increase would be 9.4 percent below the countywide increase. Over the same period, the county's northern area is expected to increase only 18.5 percent and the Decker area only 5.9 percent. The larger countywide increases show that the population on the county's reservations is likely to increase faster than in nonreservation areas.

Table III-7 shows the portion of the population resulting from the Absaloka Mine. (Population "resulting from the mine" means in-migrating employees, their families, and other in-migrating people supported, directly or indirectly, by the mine.)



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE III-1

Big Horn County's population is projected to grow 17.5 percent from its 1980 level by 1995 and 46.5 percent by 2015. The Crow and Northern Cheyenne Reservation populations are expected to grow faster than the populations off the reservations.

TABLE III-6

Forecast of Big Horn County Population

Year	Big Horn County[1]	City of Hardin	Big Horn County North (excluding city)	Decker Area
1980	12,180	3,215	978	205
1981	12,325	3,242	977	207
1982	12,421	3,245	969	203
1983	12,536	3,256	962	196
1984	12,655	3,270	958	197
1985	12,797	3,300	956	197
1986	12,931	3,326	955	197
1987	13,064	3,345	954	197
1988	13,187	3,362	953	196
1989	13,308	3,379	950	196
1990	13,585	3,481	978	203
1995	14,308	3,665	1,005	206
2000	14,966	3,797	1,016	204
2005	15,673	3,940	1,050	197
2010	16,628	4,160	1,106	207
2015	17,843	4,407	1,159	217

Source: Mountain West Research-North, Inc., 1983.

[1] Adjusted for Indian undercount in 1980 census.

Most of the miners to be hired at the Absaloka Mine would be Crow Indians who are current county residents. Hence, only about half of the county's population associated in some way with the mine would probably be people moving into the county. Those moving into the county are most likely to be non-Indians who will live off the reservation.

Housing

By 1990, the county is expected to need nearly 17 percent more housing than in 1980 (fig. III-2 and app. D, table D-5). This figure is expected to increase to over 36 percent by 2000 and over 64 percent by 2015.

Housing demand patterns in the nonreservation areas in the county would resemble population increases in those areas. None of the three jurisdictions have demands as high as the county as a whole. Hardin would probably need more housing than the other two areas, and the Decker area would probably need

TABLE III-7

Forecast of Big Horn County's Population Increase Resulting from the Absaloka Mine

Year	Total Forecasted Population	Number* From Absaloka Mine	Percent of Big Horn County Population
1983	12,536	250	2.0
1984	12,655	240	2.0
1985	12,797	240	1.8
1986	12,931	240	1.8
1987	13,064	290	2.2
1988	13,187	380	2.8
1989	13,308	380	2.8
1990	13,585	460	3.4
1995	14,308	530	3.8
2000	14,966	530	3.6
2005	15,673	530	3.4
2010	16,628	530	3.2
2015	17,843	100	0.6

Source: MWR-N, 1983.

*The number represents in-migrating employees, their families, and other in-migrating people supported (directly or indirectly) by the mine.

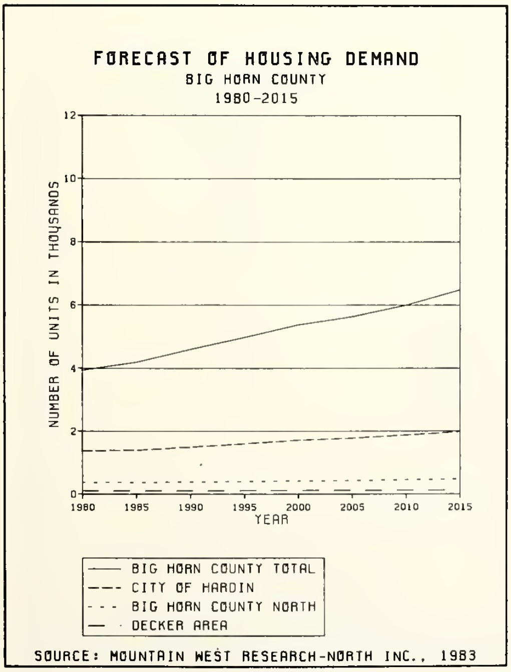


FIGURE III-2

From 4,070 units in 1983, demand for housing in Big Horn County would rise to 6,481 units by 2015, an increase of 59 percent. Increases in demand for housing in some parts of the county (the Decker area and the northern part) would not reach such high levels.

the least. The bulk of housing increases would be on the reservations. Very little of the housing demand would stem from the Absaloka Mine.

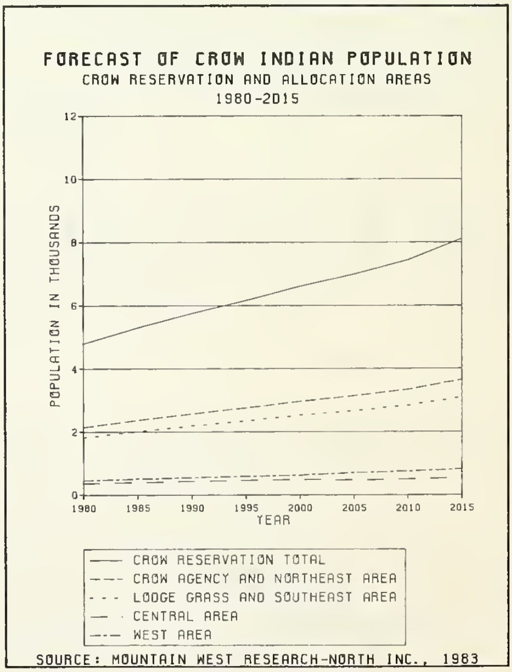
Crow Reservation

Population

The reservation's Indian population is expected to increase rapidly, regardless of Westmoreland's operation. The reservation's population is projected to rise by 22 percent from 1980 to 1990, 38 percent by 2000, and 69 percent by 2015 (fig. III-3 and app. D, table D-6). In contrast, the non-Indian reservation population is not expected to increase until after 2000, and then by only 14 percent by 2015 (fig. III-4 and app. D, table D-7). None of the population increase on the reservation would result from the Absaloka Mine's operation.

Housing

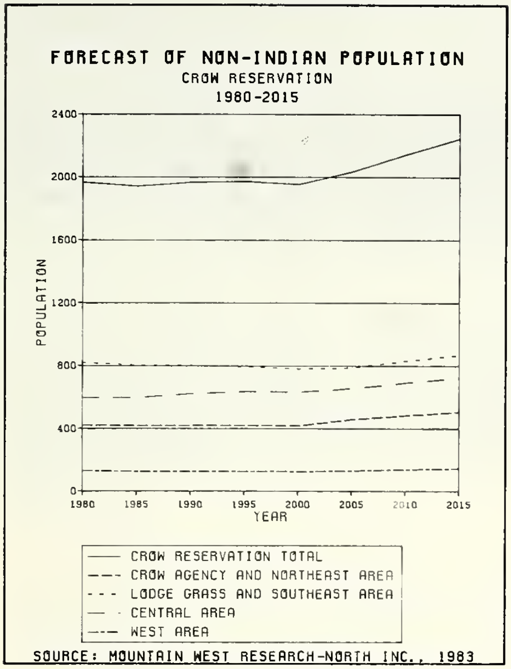
Table III-8 shows projected housing demand and the ability of local developers to meet that demand through the year 2015. Today, demand is slightly above the builders' capacity. It is likely that local builders would expand their capability or nonlocal builders would provide the capability to supply all housing needed. None of the increased housing demand would stem from the Absaloka Mine's operation.



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE III-3

Growth on the Crow Reservation will be rapid in the years ahead, rising from 5,102 in 1983 to 8,116 in 2015. The Crow Agency area will continue to be the most populated area with the Lodge Grass and southeast area close behind.



SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE III-4

The non-Indian population is not projected to grow over the next 20 years. By 2015, however, the population is projected to grow by 14 percent, rising to 2,245 from 1,948 in 1983.

TABLE III-8

Forecast of Housing Unit Demand/Supply
Crow Reservation (Crow Indian Population Only)

Year	Total Demand	Demand Over Previous Year	Local Supply Response (Limit = 40)	Cumulative (Deficit) Surplus
1980	1,117			
1981	1,150	33	33	0
1982	1,181	31	31	0
1983	1,223	42	40	(2)
1984	1,261	38	40	0
1985	1,294	33	33	0
1986	1,336	42	40	(2)
1987	1,371	35	37	0
1988	1,415	44	40	(4)
1989	1,451	36	40	0
1990	1,480	29	29	0
1995	1,645	165 for 5 years	33 per year	0
2000	1,833	188 for 5 years	38 per year	0
2005	1,936	103 for 5 years	21 per year	0
2010	2,060	124 for 5 years	25 per year	0
2015	2,247	187 for 5 years	37 per year	0

Source: Mountain West Research-North, Inc., 1983.

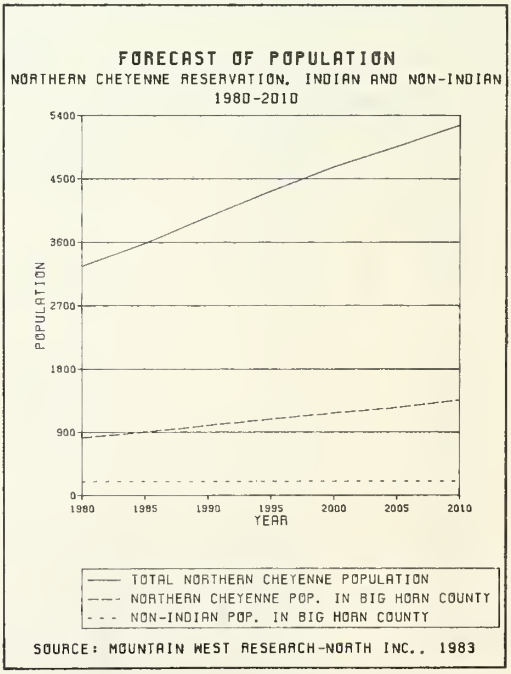
Northern Cheyenne Reservation

Population

No growth is projected for the non-Indian population, but rapid growth (over 65 percent by 2010) is forecast for the Indian population (fig. III-5 and app. D, table D-8). This is true for both the total reservation and the Big Horn County portion of the reservation. The population growth would be produced by natural increase, not from in-migration caused by mine jobs.

Housing

The demand for housing by Indians is expected to increase dramatically over the next 30 years: From the 1980 number of 217, demand would increase 30 percent by 1990, 68 percent by 2000, and 106 percent by 2010. Since housing demand arises from natural population increase, none of the demand would be related to the Absaloka Mine.


FORECAST OF POPULATION
NORTHERN CHEYENNE RESERVATION. INDIAN AND NON-INDIAN
1980-2010

SOURCE: MOUNTAIN WEST RESEARCH-NORTH INC., 1983

FIGURE III-5

In the Big Horn County portion of the reservation (center graph line) the Indian population is expected to increase from 822 in 1980 to 1,358 in 2010. Meanwhile, the non-Indian population (lower graph line) is projected to remain stable at about 196. (See also app. D, table D-8.)

SOCIAL AND COMMUNITY SERVICES

Summary of Impacts: More social and community services would be needed in Big Horn County and on the Crow Reservation in the future. All new service demands would come from natural population increase, not the continued operation of the Absaloka Mine. Thus, impacts to social and community services from mining activity would be minor.

Big Horn County

Big Horn County and Hardin are forecast to adequately serve most of their populations' needs throughout the life of the Absaloka Mine. Table III-9 summarizes social and community services and personnel needs through the year 2015.

By 2015, more facilities and personnel would be needed for the Big Horn County shop, Hardin engineering and public works department, county social services, and county schools. Only the need for school personnel is especially large. The school would need 40 additional teachers by 2015. Meeting other facility and personnel needs should present no special difficulty for the county or city, since the needs would build over a long, about 30-year, period.

The Absaloka Mine's current or continued operation hardly affects the county's projected facility and service requirements. In the proposed (13-year) mine plan (through 1995), less than 4 percent of the county's population is the result of the mine's operation. (Population "resulting from the mine" means in-migrating employees, their families, and other in-migrating people supported, directly or indirectly, by the mine.) Most new demands projected for facilities and services would stem from natural population increase.

For the life-of-mine plan, the percentage of the population resulting from the Absaloka Mine would gradually decrease after 1995. The decrease, about 0.1 percent every 5 years through 2015, would result from stable mine employment levels. That is, the number of employees (about 265) would stay the same, while the population of the county would constantly increase.

Crow Reservation

Two service areas--hospital and human and health services--are projected to require significantly more facilities and personnel over the next 30 years. By 2015, the reservation would need nine more employees and 2,400 more square

TABLE III-9
Public Facility and Personnel Requirements in Big Horn County
1984-2015

Facility/Service	Requirements Above 1983 Levels: County Facilities	County Personnel	Hardin Facilities	Hardin Personnel	Crow Reservation Facilities	Crow Reservation Personnel
General Government	0	0	0	1	0	0
Law Enforcement	0	0	na	na	0	1
Shop/Engineering/Planning	3,000 sq ft	2	+	2	na	na
Fire	0	0 (volunteers)	0	0 (volunteers)	na	na
Hospital	0	0	na	na	8 beds	5 doctors 3 dentists
Library	+	0	na	na	na	na
Human/Health/Social	800-1,300 sq ft	3	na	na	2,400 sq ft	9
Developed Parks	0	0	2 acres	0	na	na
Solid Waste	0	1	0	0	na	na
Sewage	na	na	0	0	na	na
Water	na	na	0	0	na	na
Schools	8,100 sq ft	40 teachers	na	na	na	na

Source: MWR-N. 1983
Note: na means not applicable, the jurisdiction does not supply this public service; "+" means some additional space will probably be needed, but the amount has not been determined.

feet of space to adequately supply human and health services (table III-9). and eight more hospital beds, five more doctors, and three more dentists.

None of these facility and personnel needs are the product of new population caused by the Absaloka Mine. Rather, the requirements are produced by a natural increase in population.

FISCAL CONDITIONS

Summary of Impacts: In both the application and life-of-mine plans, tax revenues would vary with coal production, but the general fiscal condition of the government units surrounding the mine would remain unchanged from recent years.

Big Horn County Government

Until shutdown, the mines in Big Horn County would continue to provide the bulk of the county's general fund revenue. This mine-related revenue (considered "local") would come mainly from property taxes on coal production, mine equipment, and facilities.

Big Horn County's future fiscal position would vary considerably, depending on mine production and the level of county services. If today's tax rate remains unchanged, for example, the county would spend more than it takes in starting in 1984 and extending through 1986. In other words, at today's level of county services, the current tax rate would not raise enough money to pay all the county's obligations. (This assumes that Spring Creek Mine would be in full production in 1986 and that no new mines would be built in the county [MWR-N, 1983, p. 4-63].)

Beginning in 1987 and continuing through the end of the century, the fiscal situation would reverse: today's tax rate would be enough to cover all obligations. When the Spring Creek, Decker, and Absaloka Mines close, as projected, in the first part of the 21st century, tax base and tax revenue would fall. Tax revenues would again become insufficient to pay for the level of services offered today. (MWR-N, 1983, p. 4-63). In 2015, the last year for which projections were made, total expenditures would more than double total revenues (MWR-N, 1983, p. 4-63).

Despite the projections, no deficits would in fact occur. The numbers merely illustrate the enormous effect of the mines' taxable value. When deficits appear in the budget, the county commission would either raise the tax rate, find other sources of revenue, or reduce expenditures (MWR-N, 1983, p. 4-63).

City of Hardin

Because the population increase resulting from Westmoreland's proposal would be small, and because the mine lies outside the town's taxing jurisdiction, future impacts would be modest. Any impacts that would occur would be difficult to distinguish from other influences unrelated to the mine. The population decline after mine closure would likewise be modest and not significantly reduce the costs of city government.

Crow Reservation

As long as Westmoreland mines coal from the Crow Tract III lease, the Tribe would have a large source of local funding not subject to the year-to-year uncertainties of federal funding. From the application area, the Tribe would receive royalties totalling about $42.4 million over 13 years (at current prices and royalty rates). Yearly payments would remain at about $2.5 million until the last three years of the mine (1995-97), when the royalty rate would change from 6 to 12.5 percent.

In the life-of-mine plan, a much greater proportion of the Crow coal production would be at the higher rate. Total royalties would amount to about $338 million. Yearly amounts would not reach above $2.5 million until 1990.

School Districts

As long as the Absaloka Mine operates, most school district funding would continue to be local. Relatively low property tax rates would continue and both the elementary and high school district (17H and 1) would not face difficulties in raising sufficient revenue to fund their operations.

The loss of taxable value caused by the closure of the mine in 1995 (2015 in life-of-mine plan) would result in a return of premining fiscal conditions in the districts. The percentage of revenue raised locally would fall sharply and the burden for school funding would be shifted to other taxpayers. The Decker area mines, while in production, would bear the brunt of the shifted tax burden. After the Decker area mines closed, much of the burden would be shifted back, through the State School Foundation program, to the other taxpayers in the state.

State Revenues

Assuming fourth quarter 1982 coal prices, state revenues from 1985-1997 production at the mine would total about $146.8 million, $133.3 million in Severance taxes, $2.2 million in Resource Indemnity Trust taxes, and $11.3 million in royalties. Annual revenue would generally be around $11.5 million. In the life-of-mine plan, state revenues would be greatly increased. Total revenues would amount to about $579 million. The Severance Tax would account for $562 million (97.1 percent of the total), Resource Indemnity Trust Taxes for $9.4 million, and royalties for about $7.7 million.

Federal Revenues

Under the proposed plan, Federal Black Lung taxes would amount to about $26.1 million and the Abandoned Mines Tax would raise $22.8 million. In the life-of-mine plan, Black Lung taxes would raise $121.6 million and the Abandoned Mines Tax $95.6 million.

LAND USE

> Summary of Impacts: Mining would temporarily eliminate agricultural uses on the minesite. After reclamation, cropland would be eliminated, ponderosa pine would decrease, and the amount of rangeland would increase (fig. III-6). The loss of agricultural production to the region would be negligible.

Grazing

After mining, the amount of rangeland in the application area would increase 59 percent, from 352 to 559 acres (table III-10). The rangeland disturbed would be out of production for approximately 5 years; 2 years for mining, regrading and revegetation and at least 3 years before cattle are allowed to graze (Michelle Mitchell, Westmoreland Resources, pers. commun., Sept. 6, 1983). Approximately 458 AUMs (animal unit months) would be lost as a result of mining in the application area. The increase in the number of acres of rangeland along with expected increased production of grassland vegetation (see Vegetation) would increase the total livestock forage available to the postmining landowner. The size of the increase would not be known until after the completion of postmining studies of vegetation and grazing potential. Stocking rates would probably be as high as today, possibly higher, owing to improved postmining range conditions and increased plant production.

Westmoreland's postmining grazing plan calls for a two-pasture rotation system. The early grazing season would extend from May through July, with the late season running from August through October. Grazing plans would be subject to approval by the Department of State Lands.

Water for cattle would be supplied by the reconstructed ponds (see Hydrology) and by two wells drilled into the sub-Robinson aquifer. Westmoreland proposes to use electric pumps to fill the stock tanks. Although the company does not specify, it is expected that the stock tanks would be in separate pastures. One stock tank would probably contain water from May through July and the other from August through October. Wildlife would probably also use stock tanks, especially with suggested modifications. (See Wildlife.)

Cropland

Because the number of acres of cropland in Tract III would decline (table II-17 and figs. II-16 and III-6) total potential annual production of both

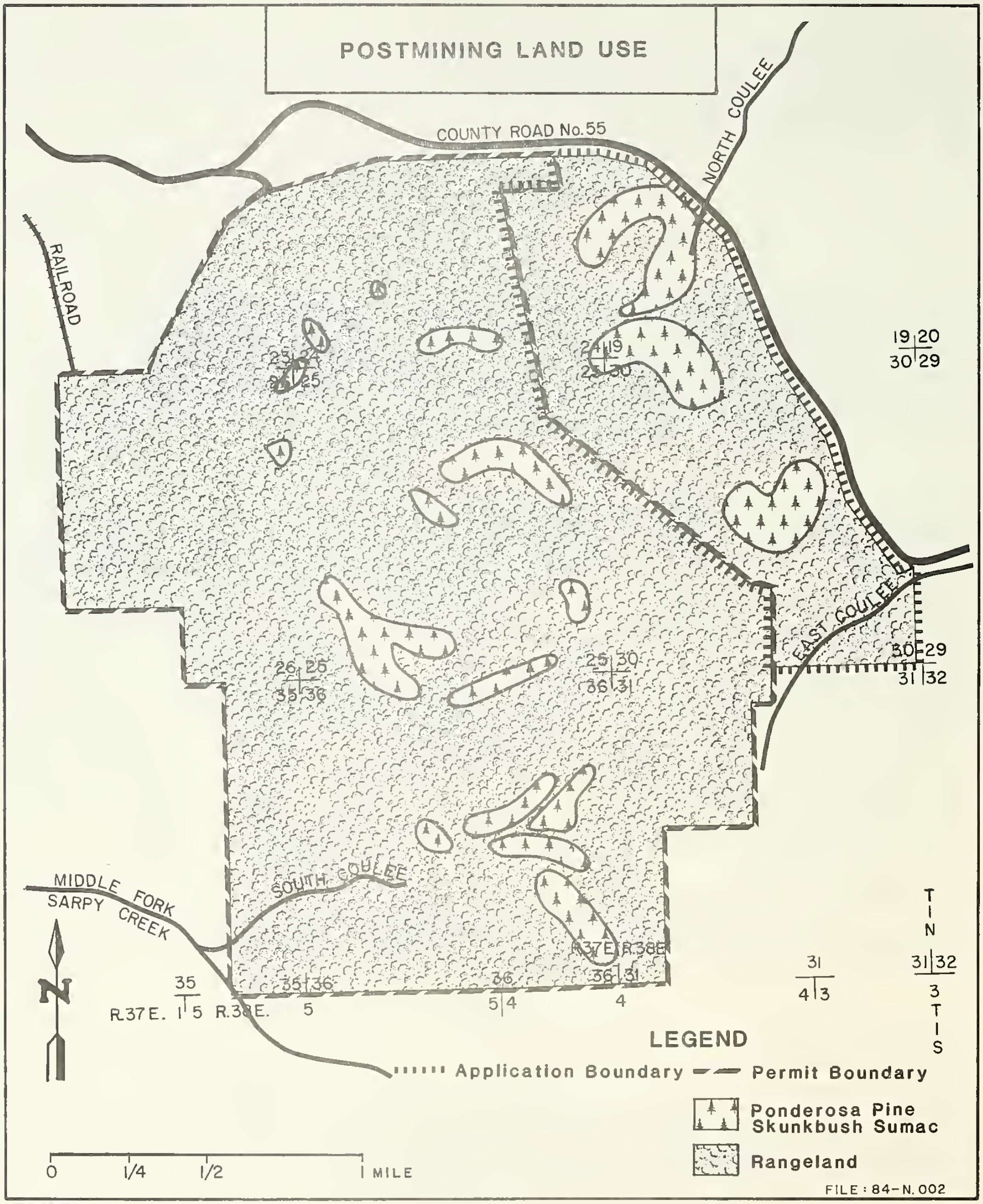


FIGURE III-6

After mining, Westmoreland would return the land to the premining land uses, primarily livestock grazing. The amount of cropland, however, would be less than before mining (fig. II-16).

TABLE III-10

Land Use Changes in the Application Area

Land Use	Acres Undisturbed	Acres Reclaimed
Rangeland	352	559
Cropland	154	0
Ponderosa Pine*	62	0
Other	5	14
TOTAL	573	573

*Closed-canopy stand.

small grains and alfalfa would decline. In the application area, the 88 acres of alfalfa hayland and 66 acres of small grains would not be replaced, but instead would be reclaimed to rangeland. At current average productivity levels, this would result in an annual loss of about 88 tons of alfalfa and either 990 bushels of wheat or 1,452 bushels of barley. In the future, these same areas, if returned to cropland, would probably produce similar yields of alfalfa and small grains because the soils replaced after mining would be similar to those that exist today. (See Soils.)

In the life-of-mine plan, a total of 394 acres of alfalfa and 721 acres of small grains would be reclaimed to rangeland. At current average productivity levels, this would result in a permanent annual loss of about 394 tons of alfalfa and either 10,815 bushels of wheat or 15,862 bushels of barley. The loss of the hayland (if permanent) would increase the postmining landowner's dependence on outside sources of hay for winter feeding.

Other Impacts

Because the population would change little as a result of the extension of the mine into the application area, little change would occur in the amount of urban use land. As happened during the 1970s, the land use changes that do occur would take place in or near existing communities.

TRANSPORTATION

Summary of Impacts: Mining as proposed would not noticeably change the amount of vehicle traffic on FAS 384 or the congestion at railroad crossings used by unit coal trains. Increased mining, at annual production rates up to 10 million tons per year, also would not noticeably affect highway traffic, but would aggravate railroad crossing congestion.

Traffic on FAS 384 would rise as mine employment rises. When the coal production rate goes from 4 million tons per year to the proposed 5-million-ton-per-year level, traffic would go up by about 24 percent. At the 10-million-ton-per-year level (the life-of-mine plan), traffic would go up by 120 percent. These increases would be well within the capacity of the newly reconstructed highway. They would not significantly change either the safety of the traveling public or the convenience of using the route.

About 2 miles of County Road 55 would have to be relocated in the life-of-mine plan. The impacts of the relocation cannot be estimated because no specific relocation plan is available. The Big Horn County Commission would have to approve the relocation.

Train traffic would also rise with production. The direction of increases in train traffic is not known, because train routes depend on the location of new coal sales. Primary market areas are expected to be the upper Midwest, where all customers are now located, and the Pacific Northwest. A reasonable assumption is that new sales will split evenly between these two market areas (David W. Simpson, Westmoreland Resources Inc., written commun., November 19, 1982).

The number of trains, at the full production level of 10 million tons per year, would average about 36 per week (18 each way) on the Westmoreland spur. Train traffic to the east of the spur (on the mainline) would increase from 14 to 25 trains per week, and traffic to the west (on the mainline) would go from zero to 11 trains per week. The increases in traffic would result in greater congestion at railroad crossings without over- or underpasses, causing increased delays in vehicle traffic. Specific problems would depend on the conditions at each crossing.

OUTDOOR RECREATION

> Summary of Impacts: Further mining at the Absaloka Mine would not affect the quality of recreation in the region.

Regional recreation areas are sufficient to adequately serve the projected population of Big Horn County and the surrounding area well beyond the life of the Absaloka Mine. Use in specific areas may, however, periodically rise beyond capacity. Where such overuse would occur is unknown. The relatively small percentage of increased use projected cannot be broken down by recreation area.

Projected recreation activities are in part based on projected population increases. The portion of future regional population increase attributable to the Absaloka Mine is insignificant. Therefore, the portion of increased regional recreational use (which is minor) associated with the mine would also be insignificant.

CULTURAL RESOURCES

Summary of Impacts: The mine would not affect significant historical or archeological sites in the mine area.

No archeologically or historically significant sites (eligible for National Register of Historic Places) would be affected by mining in the application area. In the life-of-mine area, none of the sites that might be destroyed (12 archeological and 5 historical) are eligible for the National Register.

All archeological sites in the life-of-mine area have been sufficiently recorded and, in some cases, tested and collected. The recording and collecting assure the preservation of cultural information. Historical sites have also been recorded sufficiently. In 1979, the Montana State Historic Preservation Office acknowledged that Westmoreland Resources had "...complied with section 106 of the Historic Preservation Act on Tract II and III of the Absaloka Mine..." (Westmoreland Resources, 1983, bk. J, ex. J-4, revised April 1982). This compliance means that (1) there are no impacts on sites eligible for the National Register, (2) impacts on ineligibile sites have been mitigated by data (information) collection, and (3) that plans have been submitted and approved to mitigate any additional impacts on sites discovered during mining.

Because cultural resource inventories based on current technology may not have located all significant sites or data within the survey boundaries, some unrecorded sites could be destroyed.

AESTHETICS

Summary of Impacts: Westmoreland's operations would initially destroy the landscape of the mine area. After mining, reclamation would blend the minesite with surrounding lands. In the long term, aesthetic impacts would be insignificant.

Proposed mining would not change the Absaloka Mine's industrial setting, which is now characterized by blasting, dragline excavation, coal handling, truck hauling, and facilities operation. This setting contrasts sharply with the surrounding unmined landscape.

Westmoreland proposes to mine 573 more acres. This would destroy the mined land's present scenery: rolling hills covered by ponderosa pine, grassland, and dry cropland, cut by draws growing with lush thickets of brush and small trees. The life-of-mine plan would destroy another 2,246 acres, increasing the total acreage disturbed by 2017 to 5,355.

Since reclamation would go on at the same time as mining, only about one-fifth of the 5,355 acres would be disturbed at once. At the end of mining, the reclaimed lands would have reached various stages of recovery, slowly growing toward a more natural condition, similar to surrounding lands.

The mine operations are and would continue to be visible to few people. The mine lies in an isolated area not frequently passed by visitors, and the mine lands are closed to the public. Moreover, most views from the county road near the mine are often blocked by trees and hills.

The people most affected by mining would be area residents, about a dozen families. The change from a rural agricultural setting to an industrial one may be unpleasant for these residents.

The landscape that would be removed by mining is common in the plains region east of the Rocky Mountains in Montana. (See chap. II.) The most distinctive features lost by mining, in the life-of-mine area, would be nine groups of sandstone pedestals and outcrops. Since these are common near the mine, their loss would be insignificant.

After reclamation, if revegetation is successful, the minesite would contrast little with nearby unmined lands. The reclaimed lands would have less diverse topography and vegetation, provide less interesting scenery, and may lack the appeal of unmined lands. But the topography and plants would be similar to what existed before mining. In the long term, the aesthetic impacts of mining would be insignificant.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Westmoreland Resources proposes to mine 65 million tons of coal over 13 years (or, in the life-of-mine plan, 278 million tons over the next 35 years); 9.3 million tons (or in the life-of-mine plan, 40.0 million tons) would be lost because of spillage, regulatory constraints, and limits on coal-extraction technology.

About 750,000 gallons of diesel fuel, 60,000 gallons of gasoline, and 35 million kilowatt-hours of electricity would be used at the mine each year under the proposed plan. An additional 10 million gallons per year of diesel fuel would be used to ship the coal by rail to market. In total, the proposed mine would burn 9.8 million gallons of diesel fuel, 455 million kilowatt-hours electricity, and 780,000 gallons of gasoline. Shipments by rail would consume a total of 130 million gallons of diesel fuel.

Under the life-of-mine plan, the company would use much more fuel. Each year, mine operations would on average use 1.5 million gallons of diesel fuel, 70 million kilowatt-hours of electricity, and 75,000 gallons of gasoline. Coal shipments would require another 20 million gallons of diesel fuel each year. In total, Westmoreland would consume 41 million gallons of diesel fuel, 1.9 billion kilowatt-hours of electricity, and 2.2 million gallons of gasoline. Coal shipments would demand a total of 546 million gallons of diesel fuel.

The mine plan as proposed would also use water: an average of 200 acre-feet per year, totaling 2,600 acre-feet. In the life-of-mine plan, the mine would use an average of 250 acre-feet per year, totalling 7,100 acre-feet. The majority of this water would be lost to evaporation and therefore would not be available for other uses downstream, such as agriculture. The population associated with the proposed mine would require an average of about 50 acre-feet of water per year (105 acre-feet in the life-of-mine plan).

The stratigraphy within the mine today would be permanently altered. The Rosebud-McKay and Robinson seams would be removed. Because the other strata are neither unique nor valuable, their loss would not be significant.

Eight springs would be permanently lost in the application area, and possibly three more would cease flowing, at least during mining. Of these eleven springs, three are considered perennial water supplies. Westmoreland's proposed plan to restore these lost livestock and wildlife water supplies would probably be only partially successful in that the permanent impoundment constructed to replace the springs would have an estimated 70 percent probability of containing water throughout the summer of every year. Biological productivity in and around the springs would also be permanently reduced.

Six historical sites would probably be destroyed in the application area. An additional 5 historical and 12 archeological sites would be damaged or destroyed in the life-of-mine plan. None of the sites that would be destroyed is eligible for the National Register of Historic Places. No information of historic or archeologic value would be lost, since all sites have been examined and their information recorded.

Mining in the application area would remove one great horned owl nest. The change in water sources would probably reduce the number and diversity of aquatic organisms. The closed-canopy ponderosa pine subtype would probably be eliminated, reducing thermal cover for deer. In the life-of-mine plan, mining would remove one prairie dog town, another great horned owl nest, one red-tailed hawk nest, and nine rock outcrops that may serve as habitat for a variety of animals.

Along with wildlife habitat, mining in the application area would reduce the amount of ponderosa pine vegetation type by 47 acres. The amount of drainage bottom vegetation would be halved. The closed-canopy subtype and most aquatic vegetation would probably be eliminated. Agricultural lands would also be removed from the area.

During mining, the topography of the mined area would change. The final topography would be about the same as today, though simpler. The landscape would change during mining from agricultural to industrial, but would largely return to today's condition within several decades after mining. The most distinctive features lost, in the life-of-mine area, would be nine groups of sandstone outcrops.

During mining, the acreage disturbed would not be available for grazing. Crop production during mining and afterwards would be eliminated, unless postmining landowners converted reclaimed rangeland to cropland.

SHORT-TERM USES VERSUS THE PRODUCTIVITY OF THE HUMAN ENVIRONMENT AFTER MINING

Coal from the Absaloka Mine now produces electricity and considerable tax revenues, royalties, and jobs. These benefits would continue throughout the life-of-mine plan at a cost of vegetative, wildlife, and livestock productivity.

In the long-term, after mining, the vegetative productivity and diversity of reclaimed lands would be similar to premining conditions. Coulee bottom vegetation and ponderosa pine vegetation types would take several decades to return to the approximate premining condition.

Mining would temporarily force wildlife populations from mined areas. Soon after reclamation, reclaimed grassland would again supply habitat, primarily for foraging animals. However, the regrowth of the cover provided by woody vegetation would take decades. Moreover, the complexity of vegetation types and wildlife habitat type mosaics would be simplified for many years, decreasing the quality of habitat for some species in the interim.

Aquatic habitat and associated fauna would be eliminated during mining. Species diversity and productivity, even after reclamation, would probably never equal premining conditions. The overall reduction in the quality of aquatic habitat may eliminate from the mine area certain vertebrate species, such as frogs, turtles and some songbirds.

Eight springs in the application area would be permanently destroyed by mining operations. Because they can never be replaced, any biological productivity currently dependent upon these springs would also be lost. One perennial spring that would probably cease flowing during mining may flow again following reclamation.

REJECTION OF THE APPLICATION

After reviewing Westmoreland's mining and reclamation plan, the Department of State Lands and the U.S. Department of the Interior must take one of the five alternatives listed in the introduction: (1) approve the application as proposed, (2) take no action, (3), reject the application, (4) selectively reject approval of the application, or (5) approve the application with special conditions.

Chapter III described the impacts of approving the application as proposed. The impacts of the second alternative, no action, would be same as those of approving the application as proposed. The impacts of the last two alternatives, selective rejection and approval with conditions, would be less than approval as proposed but more than rejection.

The following analysis has been written to illustrate the effects of rejection. For the purposes of this chapter, it is assumed that application rejection would result in the closure of the mine. Closure would come after Westmoreland finishes mining the coal covered in current approvals to mine.

Effects on the Physical Environment

Rejection of the application would leave 260 million tons of Rosebud-McKay and Robinson coal in the ground. All of this coal is now leased from the Crow Tribe. The coal in section 36, leased from the state of Montana, would still be mined, perhaps at a higher annual production rate than today.

At proposed coal production rates, Westmoreland would be forced by 1985 to stop mining the coal leased from the Crow. The company would stop mining in section 36 after all coal is extracted in 1990.

As a result of rejection, the overburden strata that lie above the coal seam, as well as the landscape, surface waters, vegetation, and soils, would remain undisturbed. At the close of mining, total suspended particulate concentrations on the minesite would fall to levels similar to those measured in other undeveloped areas of southeastern Montana.

Both aquatic and wildlife habitats would stay as they are today. The quality and quantity of woody cover used by deer, turkeys, grouse, and songbirds would not be lost. The vegetation and wildlife habitat type mosaics would remain complex. Two great horned owl nests, one red-tailed hawk nest, one prairie dog town, nine major sandstone outcrops, a number of acres of closed-canopy ponderosa pine forest, and 12 water sources that have been identified as important to wildlife would not be destroyed. However, the opportunity to increase wildlife foraging areas and improve pronghorn habitat through reclamation would be lost.

Rejection would stop the destruction of six historic sites. None of the sites is eligible for the National Register of Historic Places.

Effects on the Social and Economic Environment

Rejection of the application would eliminate 115 jobs. Both the number and diversity of jobs available in Hardin and on the reservation would therefore decline. Many of the mine jobs today are held by Crow Indians. The loss of these jobs and those funded by the 10 percent of the royalties used for tribal government would reduce employment opportunities for tribal members.

The effect the job losses would have on local "secondary" employment (nonmining jobs created by mine jobs) would be minor. In Montana as a whole, total employment would not necessarily be affected. Most secondary employment from the Absaloka Mine now arises in Billings, where the effect of mine closure would be negligible.

The effect on population growth from job losses would also be minor. After application rejection, the population of Big Horn County would grow 15.5 percent by 1995 (to 14,043), instead of 17.5 percent (to 14,308). The lost growth would have gone to Hardin and northern Big Horn County.

Rejection would have some impact on social conditions. Today's ties of local government, business, and individuals with their state and national counterparts would be lost.

The fiscal impact of application rejection would be enormous. In the application area alone, total Crow Tribal royalties would fall from $42.4 million to zero. The loss of this revenue would reduce the personal income of Crow Indian households by an average of about $700 per year over the 1985-1997 period.

Also severely affected fiscally would be two Big Horn County school districts: elementary district 17-H and high school district 1. Both districts would lose most of their tax base. Responsibility for school district funding would then shift in large part to the other mines in the county and Montana taxpayers in general (through the state school equalization levy).

Revenue to the State of Montana, by contrast, might not be affected by application rejection. If, for example, coal sales lost by the Absaloka Mine were taken by Rosebud, Spring Creek, or one of the Decker Mines, total state revenue would probably increase (owing to higher severance tax per ton collected from the Decker area mines). If the lost sales shifted to mines outside the state, revenue losses would be large.

Chapter V

APPENDIXES

The Decker Area Mines Comprehensive Social Sciences Study -- Appendix A

Species of Invertebrates Collected -- Appendix B

Common and Scientific Names of Wildlife Species -- Appendix C

Socioeconomic Tables -- Appendix D

Seed Mixtures for Revegetation -- Appendix E

APPENDIX A

The Decker Area Mines Comprehensive Social Sciences Study

The Department of State Lands and the U.S. Office of Surface Mining hired a consultant to analyze the socioeconomic impacts that could result from opening three new mines--CX Ranch, Wolf Mountain, and Youngs Creek. Mountain West Research-North, Inc., the consultant hired, produced a comprehensive social sciences study describing past and present conditions and forecasting these conditions for the future in Big Horn County, Montana, and Sheridan County, Wyoming. The report also covered the Northern Cheyenne and Crow Indian Reservations.

Included in the report are discussions of a wide range of topics, each analyzed under four "scenarios." The report first gives an analysis of future socioeconomic conditions if none of the three proposed mines are built. This is called the baseline scenario. The effect of the Absaloka Mine can be inferred from this scenario. Following this are three mine development scenarios: the CX Ranch Mine as proposed, the 33-year CX Ranch Mine, and all three mines.

Copies of the report are available for public review in the Big Horn County and Sheridan County libraries and through the interlibrary loan system from the Montana and Wyoming state libraries.

Definition of Study Areas

Mountain West subdivided the larger area studied. The subdivisions, or subcounty study areas, were based on the locations of the proposed mines, the composition of local labor markets, commuting patterns, and trading relationships among communities. The subcounty areas were geographically defined to conform, as closely as possible, to governmental and planning jurisdictions that could be affected by the proposed mines.

Topics and Methodologies in the Social Sciences Study

Economic and Demographic

Forecasts of population, employment, and income were prepared for each subcounty area and jurisdiction for all scenarios. The forecasts were produced by a computerized model developed by Mountain West Research, called "Planning and Assessment System" (PAS). The model, adapted to the study area, gave forecasts used to identify significantly affected areas. Those areas in which little effect was forecast were dropped from the detailed impact evaluation process.

Social Life and Cultural Diversity

The approach used for social life and cultural diversity blended field observation, interviews, community surveying, secondary data analysis, and historical research. The Guide to Social Assessment (BLM, 1982) served to organize the analysis. This was the first time the Guide was used for a mine plan in the Powder River Basin, and the Department of State Lands, Environmental Analysis Bureau, would appreciate comments on its effectiveness.

The basic assessment of social conditions was enhanced by studies of the following:

- Social history. Sheridan County, Big Horn County, the Crow Reservation, and the Northern Cheyenne Reservation were covered.
- Mine workers. This study developed a worker profile.
- Area residents in Big Horn and Sheridan Counties. Mountain West obtained information about attitudes, perceptions, social networks, and employment and demographic characteristics.
- Communities. This study delineated the response of various communities to energy development.
- Crow Reservation residents. Crow Tribe of Indians produced this study.

Housing

A housing demand and supply forecast was prepared for each subcounty area and scenario. The forecasts were based on the demographic forecasts.

Facilities and Services

A complete range of community facilities and services was examined for each scenario. The jurisdictions analyzed included two counties, the Crow Reservation, the Northern Cheyenne Reservation, five incorporated cities, five unincorporated places, three public high school and seven public elementary districts in Big Horn County, and two school districts in Sheridan County.

Fiscal

For each facility or service, detailed revenues and expenditures for each scenario were projected for affected jurisdictions. State and federal government revenues that would result from the proposed mines were also projected.

Transportation

Traffic on area roads and the rail system was projected for each scenario. The analysis included safety, capacity, and maintenance cost.

Outdoor Recreation

Average and short-term peak use of regional recreation sites was estimated for each scenario. The use was compared to the capacity of the recreational areas.

Land Use

Acreage needs by land use were projected for each scenario and compared to the land availability. The impacts of the proposed mines on land values were examined, as were land use changes on the proposed minesites.

Special Reports

In addition to the multi-volume social sciences study, Mountain West submitted twelve separate reports documenting the results of individual research efforts. The reports include:

- An historical overview of Big Horn and Sheridan Counties
- The Big Horn and Decker Mine Worker Survey
- A survey of Hardin, Decker, and Sheridan area residents
- A study of the effects of the end of coal mining
- Land value effects of the proposed mines
- An update on satisfaction, community change, and coal development in Decker, Montana
- Mining impacts on the wage rates in other employment sectors
- The effects of energy development on the cost of living and inflation
- Distribution of local purchases by the Decker area mines
- The effects of mining operations on the agricultural production of the CX Ranch
- A generic mitigation program for social and economic impacts
- The state, interstate, and federal mitigation authorities

APPENDIX B

Species of Invertebrates Collected on Westmoreland Tract III Lease Area During April, July, and October 1981

[Source: Westmoreland Resources, 1982, bk. G, vol. 3, ex. G-14, pp. 47-48]

- DIPTERA--True flies
  - Dolichopodidae--Burrowing flies
  - Tipulidae--Crane flies
    - *Tipula* sp.
  - Simuliidae--Black flies
    - *Simulium* sp.
  - Ceratopogonidae--Biting midges
  - Tribe Stilobezziini
    - *Culicoides* spp.
  - Dolichopodidae
  - Stratiomyidae--Soldier flies
    - *Euparyphus* sp.
    - *Stratiomyia* sp.
    - *Oxycera* sp.
  - Tabanidae--Horse & Deer flies
    - *Chrysops* sp.
  - Psychodidae--Moth flies
    - *Pericoma* sp.
  - Dixidae--Dixa midges
    - *Dixella* sp.
  - Chaoboridae
    - *Chaoborus* sp.
  - Culicidae--Mosquitoes
    - *Aedes campestris*
    - *A. dorsalis*
    - *A. melanimon*
    - *A. increptis*
    - *A. stictus*
    - *Culex tarsalis*
    - *C. pipiens*
    - *Anopheles freeborni*
  - Sciomyzidae
  - Chironomidae--True midges
  - Tanypodinae
    - *Larsia* sp.
    - *Macropelopia* sp.
- *hoffmeisteri*
    - *Paramerina* sp.
    - *Procladius* sp.
    - *Psectrotanypus* sp.
    - *Tanypus* sp.
    - Thienemannimyia gp.
  - Diamesinae
    - *Diamesa* sp.

- DIPTERA (continued)
  - Chironominae
    - *Chironomus* spp.
    - *Paratendipes* sp.
    - *Phaenopsectra* sp.
    - *Polypedilum* sp.
    - *Cladotanytarsus* sp.
    - *Micropsectra* sp.
    - *Tanytarsus* sp.
    - *Parachironomus* sp.
  - Orthocladinae
    - *Corynonuera* sp.
    - *Cricotopus* sp.
    - *Eukiefferiella* sp.
    - *Psectrocladius* sp.
    - *Pseudosmittia* sp.
    - *Rheocricotopus* sp.
    - *Thienemanniella* sp.

- AMPHIPODA--Freshwater shrimp
    - *Hyallela azteca*

- GASTROPODA--Snails
  - Physidae--Pouch snails
    - *Physa* sp.
  - Lymnaeidae--Pond snails
    - *Lymnaea* sp.
  - Planorbidae--Orb snails
    - *Helisoma* sp.
    - *Gyraulus* sp.

- PELECYPODA--Clams and Mussels
  - *Pisidium* sp.

- HYDRACARINA--Water mites

- OLIGOCHAETAE--Aquatic earthworms
  - Tubificidae
    - *Limnodrilus*
  - Naididae
    - *Nais communis*

- HIRUDINEA--Leeches
  - Glossiphoniidae

Appendix B
(continued)

- *COLLEMBOLA*
  - *Podura* sp.
- *EPHEMEROPTERA*--Mayflies
  - Baetidae
    - *Callibaetis* sp.
  - Caenidae
    - *Caenis* sp.
- *ODONATA*--Dragonflies
  - Aeschnidae--Darners
    - *Anax* sp.
    - *Aeshna* sp.
  - Libellulidae
    - *Sympetrum* sp.
    - *Libellula* sp.
    - *Pantala* sp.
  - Coenagrionidae--Damselflies
    - *Amphiagrion* sp.
    - *Ceonagrion* sp.
    - *Enallagma* sp.
    - *Ishnura* spp.
    - *Argia* sp.
- *HEMIPTERA*--True bugs
  - Corixidae--Water boatmen
    - *Hesperocorixa laevigata*
    - *H. Vulgaris*
    - *Palmacorixa gilletti*
    - *Sigara alternata*
    - *S. bicolorpennis*
    - *S. decoratella*
    - *S. grossolineata*
    - *Corisella tarsalis*
    - Coroxid nymphs
  - Notonectidae--Back swimmers
    - *Notonecta kirbyi*
    - *N. spinosa*
    - *N. undulata*
    - Notonectid nymphs
  - Gerridae--Water striders
    - Gerris *buenoi*
    - *G. insperatus*
    - *G. notabilis*
    - *G. remigis*
    - Gerris nymphs
  - Hebridae
    - *Merragatta* sp.
- *HEMIPTERA* (continued)
  - Mesoueliidae
    - *Mesouelia* sp.
  - Saldidae
    - *Saldula* sp.
  - Nepidae
    - *Ranatra* sp.
- *TRICHOPTERA*--Caddisflies
  - Hydropsychidae--Net spinners
    - *Hydropsyche* sp.
  - Limnephilidae--Tube-case makers
    - *Anabolia* sp.
    - *Limnephilus* sp.
- *COLEOPTERA*--Beetles
  - Curculionidae--Weevils
    - *Hyperodes* sp.
  - Dryopidae--Riffle beetles
    - *Helichus striatus*
  - Dytiscidae--Predaceous diving beetles
    - *Agabus* spp.
    - *Colymbetes* sp.
    - *Dytiscus* spp.
    - *Graphaderus* sp.
    - *Hydrophorus* spp.
    - *Hydrovatus* spp.
    - *Illybius* sp.
    - *Laccophilus* spp.
    - *Rhantus* sp.
    - *Hygrotus* sp.
  - Elmidae--Riffle beetles
    - *Stenelmis* sp.
  - Hydrophilidae--Water scavenger beetles
    - *Berosis* sp.
    - *Helophorus* sp.
    - *Hydrobius* sp.
    - *Paracymus* sp.
    - *Tropisternus* sp.
  - Haliplidae--Crawling water beetles
    - *Haliplus* spp.
    - *Peltodytes* sp.
  - Chrysomelidae--leaf beetles
    - *Donacia* sp.

APPENDIX C

Common and Scientifc Names of Wildlife Species

Common Name	Scientific Name
Mammals	
Mule Deer	*Odocoileus hemionus*
White-tailed Deer	*Odocoileus virginianus*
Coyote	*Canis latrans*
Bobcat	*Lynx rufus*
Black-footed Ferret	*Mustela nigripes*
Badger	*Taxidea taxus*
Long-tailed Weasel	*Mustela frenata*
Striped Skunk	*Mephitis mephitis*
Raccoon	*Procyon lator*
Porcupine	*Erethizon dorsatum*
Muskrat	*Ondatra zibethica*
White-tailed Jackrabbit	*Lepus americanus*
Desert Cottontail	*Sylvilagus audubonii*
Red Squirrel	*Tamiasciurus hudsonicus*
Least Chipmunk	*Eutamias minimus*
Black-tailed Prairie Dog	*Cynomys ludovicianus*
Deer Mouse	*Peromyscus maniculatus*
Meadow Vole	*Microtis pennsylvanicus*
Prairie Vole	*Microtis ochrogaster*
Wyoming Pocket Mouse	*Perognathus fasciatus*
Masked Shrew	*Sorex cinereus*
Birds	
Merriam's Wild Turkey	*Meleagris gallopavo*
Sharp-tailed Grouse	*Pedioecetes phasianellus*
Ring-necked Pheasant	*Phasianus colchicus*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Green-winged Teal	*Anas carolinensis*
Blue-winged Teal	*Anas discors*
American Widgeon	*Mareca americana*
Shoveler	*Spatula clypeata*
Northern Harrier (Marsh Hawk)	*Circus cyaneus*
Red-tailed Hawk	*Buteo jamaicensis*
Golden Eagle	*Aquila chrysaetos*
Bald Eagle	*Haliaeetus leucocephalus*
Prairie Falcon	*Falco mexicanus*
American Kestrel	*Falco sparverius*
Peregrine Falcon	*Falco peregrinus*
Great-horned Owl	*Bubo virginianus*
Screech Owl	*Otus asio*
Robin	*Turdus migratorius*
Yellow Warbler	*Dendroica petechia*
Rufous-sided Towhee	*Pipilo erythrophthalmus*
Western Meadowlark	*Sturnella neglecta*
Vesper Sparrow	*Pooecetes gramineus*

Appendix C
(continued)

Common Name	Scientific Name
Birds (cont.)	
Red Crossbill	Loxia curvirostra
Black-capped chickadee	Parus atricapillus
Solitary Vireo	Vireo solitarius
Reptiles and Amphibians	
Spadefoot Toad	Scaphiopus bombifrons
Western Toad	Bufo boreas
Western Painted Turtle	Chrysemys picta
Yellow-bellied Racer	Coluber constrictor
Gopher Snake	Pitouphis melanoleucus
Prairie Rattlesnake	Crotalus viridis
Fish	
White Sucker	Catastomus comersoni
Lake Chub	Couesius plumbeus

APPENDIX D

SOCIOECONOMIC TABLES

TABLE D-1

Big Horn County Population

Area	1970	1980	Percent Change
Montana	694,409	786,690	13.3
Male	347,005	392,625	13.1
Female	347,404	394,065	13.4
Big Horn County	10,057	11,096	10.3
Male	4,990	5,480	9.8
Female	5,067	5,616	10.8
Hardin City	2,733	3,300	20.7
Big Horn County North	110	949	762.7
Decker Area	245	189	-22.9

Source: U.S. Department of Commerce, Bureau of the Cenus, 1970 Census of the Population: Characteristics of the Population, Montana, Tables 19, 20, 34, 35, 49, 50; U.S. Department of Commerce, Bureau of the Census, 1980 Census of the Population: Characteristics of the Population, Montana, Tables 19, 20, 46.

Note: These figures do not reflect the undercount of Crow Indians in the 1980 U.S. Census.

TABLE D-2

Big Horn County Housing Units by Type

Type of Unit	1970	1980	Increase in Number of Units	Percent 1970-1980 Growth
Total Housing Units	2,900	3,867	967	33.3
Year-round Units	2,866	3,719	853	29.8
Single-family detached	2,420	2,777	357	14.8
Multifamily	273	467	194	71.1
Mobile homes	173	475	302	174.6

Source: U.S. Department of Commerce, Bureau of the Census, Detailed Housing Characteristics for Montana, 1970, 1980.

TABLE D-3

1980 U.S. Census and Revised Population Counts

Place	1980 Census[a]		Revised Count[b]	
	Total Population	Crow Indian	Total Population	Crow Indian
Big Horn County	11,096	5,315	12,180	6,375
Crow Reservation	5,645	3,840	6,758	4,792
Crow Agency and Northeast Area	2,100	1,696	2,564	2,144
Lodge Grass and Southeast Area	2,136	1,438	2,647	1,827
Central Area	937	343	958	362
West Area	472	363	589	459

Sources: [a] Department of Commerce, U.S. Bureau of the Census, 1980 Census Preliminary Population and Housing Unit Counts, January, 1981.
[b] Mountain West Research-North, Inc., 1982.

TABLE D-4
Public Outdoor Recreation Areas of Regional and County Importance

Area	Ownership*	Acres	Comments
REGION			
Pryor Mountain Wild Horse Range	BLM-NPS		Borders Big Horn County
Bighorn National Forest	USFS	1,115,125	Segment in Sheridan County; 0.7 percent in other ownership
Bighorn Canyon National Recreation Area	NPS	120,284	Segment in Big Horn County; 43.3 percent in other ownership
Ashland Division of Custer National Forest	USFS	502,152	Borders Big Horn County; 13 percent in other ownership
Pryor Division of Custer National Forest	USFS		Borders Big Horn County
BIG HORN COUNTY, MONTANA			
Arapooish Fishing Access Site	MDFWP		Deeded land along the Bighorn River within the boundaries of the Crow Reservation
Bighorn Fishing Access Site	MDFWP		Deeded land along the Bighorn River within the boundaries of the Crow Reservation
Two Leggins Fishing Access Site	MDFWP		Deeded land along the Big Horn River within the boundaries of the Crow Reservation
Grant Marsh Fishing Access Site	MDFWP	140	Access to Bighorn River 8 miles west of Hardin
Tongue River Reservoir	DNRC		Tongue River
Rosebud Battlefield	MDFWP	5,000	Historic Site with hunting in season
Custer Battlefield National Monument	NPS	755	Historic Site on Crow Reservation
Chief Plenty Coups State Monument	MDFWP	195	Historic Site on Crow Reservation
Scattered Parcels of Public Land	BLM	27,686	Generally Inaccessible

Sources: Montana Department of Fish and Game, Montana Statewide Comprehensive Outdoor Recreation Plan (SCORP), vol. 2., March, 1978; Bureau of Land Management, Public Information Office, 1982.

*BLM=Bureau of Land Management, NPS=National Park Service, USFS=U.S. Forest Service, MDFWP=Montana Department of Fish, Wildlife and Parks, DNRC=Montana Department of Natural Resources and Conservation.

TABLE D-5

Forecast of Big Horn County Housing Demand

Year	Big Horn County	City of Hardin	Big Horn County North	Decker Area
1980	3,935	1,371	364	96
1981	3,996	1,375	365	97
1982	4,011	1,368	363	96
1983	4,070	1,374	364	95
1984	4,126	1,380	365	96
1985	4,189	1,393	366	97
1986	4,262	1,406	368	98
1987	4,326	1,417	369	99
1988	4,406	1,433	372	100
1989	4,466	1,443	372	100
1990	4,596	1,496	385	104
1995	4,974	1,607	401	109
2000	5,374	1,721	418	113
2005	5,632	1,784	432	109
2010	5,997	1,882	455	114
2015	6,481	1,985	476	120

Source: Mountain West Research-North, Inc., 1983.

TABLE D-6

Forecast of Crow Indian Population
Crow Reservation and Allocation Areas

Year	Crow Reservation	Crow Agency and Northeast Area	Lodge Grass and Southeast Area	Central Area	West Area
1980	4,792	2,144	1,827	362	459
1981	4,895	2,189	1,865	371	470
1982	4,996	2,235	1,902	379	480
1983	5,102	2,282	1,941	388	491
1984	5,199	2,326	1,977	395	501
1985	5,300	2,371	2,015	403	511
1986	5,392	2,413	2,050	409	520
1987	5,486	2,456	2,085	416	529
1988	5,579	2,498	2,120	423	538
1989	5,669	2,539	2,155	429	546
1990	5,753	2,577	2,188	434	554
1995	6,162	2,763	2,350	459	590
2000	6,611	2,970	2,531	483	627
2005	6,992	3,143	2,671	471	707
2010	7,439	3,343	2,842	502	752
2015	8,116	3,648	3,100	547	821

Source: Mountain West Research-North, Inc., 1983.

TABLE D-7

Forecast of Crow Reservation Non-Indian Population

Year	Crow Reservation	Crow Agency and Northeast Area	Lodge Grass and Southeast Area	Central Area	West Area
1980	1,966	420	820	596	130
1981	1,966	419	818	600	129
1982	1,956	419	812	597	128
1983	1,948	419	807	596	126
1984	1,943	418	804	595	126
1985	1,941	418	801	597	125
1986	1,940	418	799	599	124
1987	1,939	418	794	601	123
1988	1,937	418	797	602	123
1989	1,933	417	791	603	122
1990	1,966	419	800	622	125
1995	1,972	418	793	636	125
2000	1,952	417	779	632	124
2005	2,034	459	788	656	131
2010	2,143	484	830	691	138
2015	2,245	507	869	724	145

Source: Mountain West Research-North, Inc., 1983.

TABLE D-8

Forecast of Population of Northern Cheyenne Reservation

Year	Total Northern Cheyenne Population	Northern Cheyenne Population (Big Horn County)	Non-Indian Population (Big Horn County)
1980	3,255	822	196
1985	3,583	904	194
1990	3,960	1,000	198
1995	4,324	1,092	200
2000	4,670	1,180	200
2005	4,958	1,255	199
2010	5,262	1,358	197

Source: Mountain West Research-North, Inc., 1983.

APPENDIX E

Seed Mixtures for Revegetation

Species	Percent of Mix Lowland Grassland[1]	 Upland Grassland[2]	 Drainage Bottom[3]
Cool Season Grasses			
Western wheatgrass (Agropyron smithii)	15	5	40
Green needlegrass (Stipa viridula)	15	5	0
Beardless wheatgrass (Agropyron inerme)[4]	15	10	0
Slender wheatgrass (Agropyron trachycaulum)	3	0	10
Thickspike wheatgrass (Agropyron dasystachyum)	2	0	10
Prairie junegrass (Koelaria cristata)	2	0	0
Kentucky bluegrass (Poa pratensis)	0	0	20
Warm Season Grasses			
Blue grama (Bouteloua gracilis)	10	0	0
Sideoats grama (Bouteloua curtipendula)	10	15	0
Little bluestern (Schizachyrium scoparium)	0	15	0
Sand bluestem (Andropogon halli)	0	15	0
Prairie sandreed (Calamovilfa longifolia)	0	15	0
Big bluestem (Andropogon geradi)	0	0	20
Forbs[5]	27	19	0
Shrubs[5]	1	1	0

---

[1] Seeding rate: 40 pure live seeds/square foot; about 15 lbs. pure live seeds/acre.

[2] Seeding rate: 24 pure live seeds/square foot; about 15 lbs. pure live seeds/acre.

[3] Seeding rate: 45 pure live seeds/square foot; about 15 lbs. pure live seeds/acre.

[4] Bluebunch wheatgrass (Agropyron spicatum), an ecological equivalent, would be used when available.

[5] See appendix F for species.

APPENDIX F

Forb, Shrub, and Tree Revegetation Mixtures

TABLE F-1
Forb and Shrub Species Used in Revegetation Seed Mixtures

Seed Mixture	Forage Class	Name	Scientific Name
Lowland grassland	Forb	Western yarrow	Achillea millefolium
		Purple prairie clover	Petalostemum purpureum
		Prairie coneflower	Ratibida columnifera
		Black Sampson	Echinacea angustifolia
		Dotted gayfeather	Liatris punctata
		Sainfoin	Onobrychis sp.
		Cicer milkvetch	Astragalus sp.
	Shrub	Fourwing saltbush	Atriplex canescens
		Silver sagebrush	Artemisia cana
Upland grassland	Forb	Arrowleaf balsamroot	Balsamorhiza sagittata
		Western yarrow	Achillea millefolium
		Purple prairie clover	Petalostemum purpureum
		Black Sampson	Echinacea angustifolia
		Dotted gayfeather	Liatris punctata
		Flax	Linum sp.
		Sainfoin	Onobrychis sp.
	Shrub	Skunkbush sumac	Rhus trilobata
		Yucca	Yucca glauca

Note: Species proportions would depend on cost and availability.

TABLE F-2
Shrub and Tree Species Proposed For Drainage Bottom Reclamation

Name	Scientific Name	Percent of Total Planting[1]
American plum	Prunus americana	30-60
Chokecherry	Prunus virginiana	20-40
Golden currant	Ribes sp.	5-10
Hawthorn	Crataegus columbiana	5-10
Buffaloberry	Shepherdia sp.	0-5
Skunkbush sumac	Rhus trilobata	0-5
Box elder	Acer negundo	0-5
Green ash	Fraxinus sp.	0-5
Cottonwood	Populus sp.	0-5
Wood's rose	Rosa woodsii	0-5

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[1] 1,000 seedlings/acre.

APPENDIX G

Common and Scientific Names of Plant Species

Common Name	Scientific Name
Grasses and grasslike	
Western wheatgrass	*Agropyron smithii*
Penn sedge	*Carex pennsylvanica*
Neddle-and-thread	*Stipa comata*
Prairie junegrass	*Koelaria cristata*
Sideoats grama	*Bouteloua curtipendula*
Bluebunch wheatgrass	*Agropyron spicatum*
Little bluestem	*Schizachyrium scoparium*
Prairie sandreed	*Calamovilfa longifolia*
Japanese brome	*Bromus japonicus*
Idaho fescue	*Festuca idahoensis*
Slough sedge	*Carex atherodes*
Basin wildrye	*Elymus cinerus*
Big bluestem	*Andropogon geradi*
Bluegrass	*Poa* spp.
Cattail	*Typhus* spp.
Bulrush	*Scirpus* spp.
Sedge	*Carex* spp.
Garrison creeping foxtail	*Alopecurus arundinaceus*
Forbs	
Western yarrow	*Achillea millefolium*
Hood's phlox	*Phlox hoodii*
Broom snakeweed	*Xanthocephalum sarothrae*
Shrubs and Trees	
Yucca	*Yucca glauca*
Skunkbush sumac	*Rhus trilobata*
Silver sage	*Artemisia cana*
Ponderosa Pine	*Pinus ponderosa*
Snowberry	*Symphoricarpos occidentalis*
Rose	*Rosa* spp.
Hawthorne	*Crataegus columbia*
Plum	*Prunus americana*
Chokecherry	*Prunus virginiana*
Buffaloberry	*Shepherdia* spp.
Green ash	*Fraxinus* spp.
Box elder	*Acer negundo*

LITERATURE CITED

Amstrup, S.C. 1978. Activities and habitat use patterns of pronghorns on Montana-Wyoming coal lands. Biennial Pronghorn Antelope Workshop 8: 207-306.

Anderson, D.R., and F.A. Glover. 1967. Effects of water manipulation on waterfowl production and habitat. Transactions of North American Wildlife and Natural Resources Conference 32:292-300.

Berg, P.T. 1956. A study of waterfowl broods in eastern Montana with special reference to movements and relationship of reservoir fencing to production. Journal of Wildlife Management 20:253-262.

Bjugstad, A.J. 1978. Reestablishment of woody plants on mine spoils and management of mine water impoundments: An overview of Forest Service research on the Northern Great Plains, pages 3-12. In The reclamation of disturbed lands, ed. R.A. Wright. Albuquerque: University of New Mexico Press.

Bjugstad, A.J. 1984a (in press). Establishment of trees and shrubs on lands disturbed by mining in the West. In Proceedings of Land Reclamation Working Group, Society of American Foresters.

Bjugstad, A.J. 1984b (in press). Shrub and tree establishment on coal spoils in northern high plains--USA. Minerals and Environment.

Bjugstad, A.J., T. Yamammoto, and D.W. Uresk. 1981. Shrug establishment on coal and bentonite clay mine spoils, pages 104-122. In Proceedings of Symposium on Shrub Establishment on Disturbed Arid and Semiarid Lands.

Boeker, E.L., and V.E. Scott. 1969. Roost tree characteristics for Merriam's turkey. Journal of Wildlife Management 33(1): 121-124.

Crow Tribe of Indians and American Indian Technical Services. 1983. Socioeconomic impact assessment: Shell's proposed Young's Creek Mine Crow Indian Reservation Montana. Broomfield, Colo. 134 pages and appendixes.

Dollhopf, D.J., E.J. De Puit, and M. G. Klages. 1980. Chemical amendment and irrigation effects on sodium migration and vegetation charcteristics in sodic mine soils in Montana. Reclamation Research Technology. Bulletin 736, Montana Agricultural Experiment Station, Montana State University, Bozeman, Mont. 109 pages.

Ecological Consulting Service. 1976a. The Montana Power Company, Colstrip 10 x 20 area, Wildlife and wildlife habitat annual monitoring report. Project no. 135-85-A. 54 pages.

Ecological Consulting Service. 1976b. Sharp-tailed grouse research. Report no. 2 for Montana Power Company. 36 pages.

Einarsen, A.S. 1948. The pronghorn antelope and its management. Washington, D.C.: Wildlife Management Institute. 235 pages.

Erdman, J.A., R.J. Ebens, and A.A. Case. 1978. Molybdenosis: A Potential Problem in Ruminants Grazing on Coal Mine Spoils. Journal of Rangge Management 31(1):34-36.

Evans, K.E., and R.R. Kerbs. 1977. Avian use of livestock watering ponds in western South Dakota. Fort Collins, Colo: U.S. Department of Agriculture, Forest Service General Technical Report RM-35, 11 pages.

George, H.A. 1963. Planting alkali bulrush for waterfowl food. California Department of Fish and Game Management Leaflet 9. 9 pages.

Gough, L.P., H.T. Schacklette, and A.A. Case. 1979. Elememt concentrations toxic to plants, animals, and man. U.S. Geological Survey Bulletin 1477. 80 pages.

Hadley, R.F., and Toy, T.J., 1977. Relation of surfician erosion on hillsopes to profile geometry: Journal of Research of United States Geological Survey 5(4): 487-490.

Historical Research Associates. 1983. Historical overview: Decker area mines project, Big Horn County, Montana, and Sheridan County, Wyoming, 1870-1970. Missoula, Mont. 115 pages.

Hite, W.A. 1974. Container field performance in the Rockies and Plains, pages 306-309. In Proceedings of North American Containerized Forest Tree Seedling Symposium, Great Plains Council Publication No. 68.

Hoffman, L., and R.E. Ries. 1980. Comparison of vegetative composition, cover, and production on reclaimed and nonmined grazed lands, pages 17-1 through 27-10. In Adequate reclamation of mines lands?--A symposium. Soil Conservation Society of America and Western Agricultural Experiment Station, Billings, Montana, March 26-27, 1980.

Jackman, S.M., and J.M. Scott. 1975. Red-tailed hawk (Buteo jamaicensis), pages 68-84. Literature review of twenty-three selected forest birds of the Pacific Northwest. U.S. Department of Agriculture, Forest Service, Region 6.

Jensen, I.B., and R.L. Hodder. 1979. Tubelings, condensation traps, mature tree transplanting, and root sprigging techniques for tree and shrub establishment in semiarid areas. Montana Agricultural Experiment Station, Montana State Univ., Res. Rep. 141(2). 105 pages.

Kay, B.L. 1980. Mulch choices for erosion control and plant establishment. Weeds, Trees, and Turf 19(8): 16-24.

Linde, A.J., J. Janisch, and D. Smith. 1976. Cattail--The significance of its growth, phenology and carbohydrate storage to its control and management. Madison, Wisconsin: Department of Natural Resources Technical Bulletin 94, 27 pages.

Long, S.G. 1981. Characteristics of plants used in western reclamation. 2d ed. Fort Collins, Colo.: Environment and Research Technology. 138 pages.

Lusby, G.C., and Toy, T.J. 1976. An evaluation of surface-mine spoils area restoration in Wyoming using rainfall simulation: Earth Surface Processes 1:375-386.

Montana Department of Highways, Planning and Research Bureau. 1981. Traffic by sections, 1981. Helena, Mont. 345 pages.

Montana Department of Revenue. 1983. Report of the State Department of Revenue, July 1, 1980 to June 30, 1982. Helena, Montana: Montana Department of Revenue. 121 pages.

Montana Department of State Lands, 1977. Final environmental impact statement for the proposed expansion of Westmoreland Resources' Absaloka Mine into section 36, T1N, R37E. Helena, Mont. 138 pages and appendices.

---- 1979. Draft environmental impact statement on the proposed mining and reclamation plan for Westmoreland Resources' Absaloka Mine, Big Horn County, Montana. Helena, Mont. 101 pages.

---- 1981. Montana Financial Report, 1980-81. Helena, Montana. 442 pages.

---- April 1, 1983. Reclamation Division, Coal and Uranium Bureau, quarterly report. Unpublished. Available at Helena office of Department of State Lands.

---- 1983. Final comprehensive environmental impact study, Western Energy Company's Rosebud Mine. Helena, Mont. 388 pages.

Mountain West Research-North, Inc. 1983. Decker area mines comprehensive social sciences study. Billings, Mont. 3 volumes, 1,604 pages.

Munshower, R.R., and D.R. Neuman. 1978. Trace element concentrations in vegetation from revegetated strip mined lands and native range in southeastern Montana. In: Ecology and Coal Resource Development, M.K. Wali (Ed.) pp. 887-891, Pergamon Press, New York, NY.

Northern Cheyenne Tribe Planning Office. 1981. Report to Montana Department of State Lands. Lame Deer, Mont. 116 pages and attachments.

Orr, H.K. 1977. Reestablishment of wooded waterways and associated shrub communities in surface coal mining areas of the northwestern Great Plains. Proceedings of 5th Symposium on Surface Mining and Reclamation, NCA/BCR Coal Conference, Exposition No. 4:235-243.

Rausch, B., S. Steinberg and J. Schneider. 1982. Montana air quality data and information summary for 1981. Helena, Mont.: Air Quality Bureau, Department of Health and Environmental Sciences. 181 pages.

Rouse, C.H. 1959. Antelope range relationships. Trans. Interstate Antelope Conf. 10:4-9.

Severson, K.E., and M. May. 1967. Food preferences of antelope and domestic sheep in Wyoming's Red Desert. Journal of Range Management 20(1):21-25.

Sindelar, B.W. 1980. Achieving revegetation standards on surface mined lands, pages 22-1 through 22-15. In Adequate reclamation of mined lands?--A symposium. Soil Conservation Society of America and Western Agricultural Experiment Station, Billings, Montana, March 26-27, 1980.

Stiller, D.M., G.L. Zimpfer, and M. Bishop. 1980. Application of geomorphic principles to surface mine reclamation in the semiarid West. Journal of Soil and Water Conservation 35(6): 274-277.

Stoeckeler, J.H., and P.E. Slabaugh. 1965. Conifer nursery practice in the prairie-plains. U.S. Department of Agriculture, Forest Service Agricultural Handbook 279.

Thomas, J.W., H. Black Jr., R.J. Scherzinger, and R.J. Pederson. 1979. Deer and elk, pages 104-127. In Wildlife habitats in managed forests, the Blue Mountains of Oregon and Washington, ed. J.W. Thomas. U.S. Department of Agriculture, Forest Service. Agric. Handbook 553.

Toy, T.J., and B.E. Munson. 1978. Climate appraisal maps of the rehabilitation potential of strippable coal lands in the Powder River Basin, Wyoming and Montana. Denver: U.S. Geological Survey. 2 pages.

U.S. Department of Agriculture, Soil Conservation Service. 1971. Big Horn County soil survey range site descriptions and technician's guide to range site, condition classes, and recommended stocking rates in Soil Conservation District of the Sedimentary Plains of Montana 15"-19" precipitation zone. Unpublished report.

U.S. Department of Agriculture, Soil Conservation Service, and U.S. Department of the Interior, Bureau of Indian Affairs. 1977. Soil Survey of Big Horn County Area, Montana. Washington, D.C.: U.S. Government Printing Office.

U.S. Department of the Interior. 1977. Final environmental statement on the proposed 20-year plan of mining and reclamation, Westmoreland Resources tract III, Crow Indian Ceded Area, Montana. Reston, Virginia. 495 pages and appendices.

---- Bureau of Indian Affairs. 1974. Final Environmental Impact Statement, Crow Ceded Area Coal Lease, Tract III. Billings, Montana.

---- 1976. Final Environmental Impact Statement, Crow Ceded Area Coal Lease, Tracts II and III. Billings, Montana.

U.S. Department of the Interior and Montana Department of State Lands. 1980. Final environmental impact statement, regional analysis, Northern Powder River Basin coal, Montana. Helena, Mont. 4 volumes.

Westech. 1977. Hydrologic system comparison report, by M.K. Botz. Unpublished.

Westmoreland Resources Inc. 1983. Absaloka Mine permit application. 12 volumes. Hardin, Mont.

Yeo, R.R. 1964. Life history of the common cattail. Weeds 12:284-288.

Chapter VII

CONSULTATION AND COORDINATION

RESEARCH AND WRITING

The following people prepared the EIS:

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Stiller and Associates Inc. prepared the hydrology and geology section of the EIS.

All maps in the EIS were prepared, under the direction of Don Ellingson, by Westmoreland Resources.

REVIEW

The following people from the Department of State Lands reviewed this document:

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Sandi Olsen, Coal Bureau Chief

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The following people from the Office of Surface Mining also reviewed this document:

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PEOPLE, AGENCIES, AND COMPANIES CONSULTED

The following agencies and companies (other than those cited in the text) provided information used to analyze Westmoreland Resources' mine plan:

Big Horn County Commission, Hardin, Montana

City of Sheridan, Sheridan, Wyoming

Crow Tribe of Indians

Kiewit Mining and Engineering Co., Sheridan, Wyoming

Montana Bureau of Mines and Geology, Billings, Montana

Montana Department of Commerce, Helena, Montana

Montana Department of Fish, Wildlife, and Parks, Helena, Montana

Montana Department of Health and Environmental Sciences, Air Quality Bureau, Helena, Montana

Montana Department of Highways, Helena, Montana

Montana Department of Institutions, Helena, Montana

Montana Department of Natural Resources and Conservation, Helena, Montana

Montana Department of Revenue, Helena, Montana

Montana Department of Social Rehabilitation Services, Helena, Montana

Montana Department of State Lands, Coal Bureau, Helena, Montana

Northern Cheyenne Planning Office, Lame Deer, Montana

Sheridan County Commission, Sheridan, Wyoming

State Historic Preservation Office, Helena, Montana

U.S. Department of Health and Human Services, Indian Health Services, Billings, Montana

U.S. Department of the Interior, Bureau of Indian Affairs, Billings, Montana

U.S. Department of the Interior, Bureau of Land Management, Billings, Montana

U.S. Department of the Interior, Bureau of Land Management, Miles City, Montana

The Department of State Lands and Office of Surface Mining appreciate the assistance of Westmoreland Resources, Inc. The company provided the Environmental Analysis Bureau with information on the proposed mine and drafted all of the maps in the EIS.

REVIEW OF THIS STATEMENT

In accordance with environmental law, copies of this draft EIS will be made available to the public for comments and suggestions. All comments received will be carefully considered in the preparation of the final EIS. Comments can be sent to Commissioner Dennis Hemmer, Montana Department of State Lands, Capitol Station, Helena, MT 59620.

The draft EIS is available for review in the following places:

- Montana Department of State Lands, 1625 11th Avenue, Helena, Montana.
- Big Horn County Public Library, 419 North Custer Avenue, Hardin, Mont.
- Miles City Public Library, 1 South 10th, Miles City, Montana.
- The Rosebud County Library, 201 North 9th Avenue, Forsyth, Montana.
- Parmley Billings Public Library, 510 North Broadway, Billings, Mont.
- Sheridan County Fulmer Public Library, 320 N. Brooks, Sheridan, Wyom.

Copies are also available on request from the Department of State Lands, Capitol Station, Helena, MT 59620 and from the Office of Surface Mining, Western Technical Center, Brooks Towers, Second Floor, 1020 15th Street, Denver, Colorado 80202.

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